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ERRATA

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Page 35, line 22: for "Roemer" read "White (not Roemer)."

Page 116, last line: for "Table II" read "Table 2."

Page 117, Table 1: below side head "*F_1 progeny of original plant of strain E*" insert a rule across entire table.

Page 120, line 23: after "$\alpha\beta$Ff" insert "flat."

Page 123, line 27: delete comma after "generation."

Page 123, line 36: insert arrow (→) between "αFβF" and bracket.

Page 124, line 14: for "and" read "an."

Page 124, last line: for "435" read "425."

Page 142, lines 32, 34, and 43: for "*Asterodiscocylina*" read "*Asterodiscocyclina.*"

Page 143, lines 8 and 30: for "*Discocylina*" read "*Discocyclina.*"

Page 143, line 29: for "*Asterodiscocylina*" read "*Asterodiscocyclina.*"

Page 145, lines 26 and 27: for "*Discocylina*" read "*Discocyclina.*"

Page 145, line 26: for "*Asterodiscocylina*" read "*Asterodiscocyclina.*"

Page 234, line 27: for "uncomformably" read "unconformably."

Page 235, line 14: for "*Discocylina*" read "*Discocyclina.*"

Page 235, line 16: for "*Asterodiscocylina*" read "*Asterodiscocyclina.*"

Page 242, line 30: for "Pseudoceratities" read "Pseudoceratites."

Page 245, line 14: for "specimes" read "specimens."

Page 264, line 5 in right column of table, for "farthert" read "farther."

Page 266, last line: delete "Soc."

Page 267, line 27: for "The table" read "Table 1, p. 264."

Page 269, line 32: for "remoralis" read "nemoralis."

Page 283, legend of fig. 1: for "*Rhabditella*" read "*R.* (*Rhabditella*)."

Page 284, legend of fig. 2: same correction as to fig. 1, p. 283.

Page 284, line 41: for "*Iuffa*" read "*Luffa.*"

Page 285, legend of fig. 4, for "*myolablatum*" read "*myolabiatum* n. sp."

Page 285, legend of fig. 5: for "L. *myolablatum* read "*myolabiatum* n. sp."

Page 286, legend of fig. 6: for "*Thelastoma*" read "*T.* (*Thelastoma*)" and for "*Thelastomellum*" read "*T.* (*Thelastomellum*)."

Page 291, line 15: for "griesenization" read "greisenization."

Page 290, line 3 from bottom: for "case" read "cases."

Page 319, line 24: for "0.002" read "0.0002."

Page 386, line 13: for "Baltimore" read "Biltmore."

Page 415, line 40: for "prickels" read "prickles."

JOURNAL

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PHYSICAL GEOGRAPHY.—*The vegetation, stratigraphy, and age of the "Open Land" peat area in Carteret County, North Carolina.*[1]

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INTRODUCTION

From August 26 to September 12, 1928, a brief examination of an area of peat known as the "Open Land" was made in Carteret County, North Carolina, in cooperation with the State College of Agriculture. The aim was to determine the origin, structure, and age as well as the peculiar peat problems presented by this type of coastal swamp, also to study intensively the relation of its distinctive vegetation to certain habitat factors, and the effects of the removal of excess water by drainage.

The "Open Land" comprises approximately 50,000 acres and is located about 12 miles northeast from Beaufort. The surface of the peat area has a moderately convex form, characteristic of certain peat deposits in maritime regions. The area is the highest land, lying from 6 to 11 feet above sea level, and is almost without stream erosion or relief of any sort except low marginal sandy ridges. It is situated in the central part of a peninsula which is bounded by Back Sound, Core Sound, Pamlico Sound, Neuse River, Adams Creek and the Inland Canal.

HISTORY

Carteret County has been an important gateway to the mainland (4).[2] Explorers and settlers came there at an early date in the history

[1] Received November 12, 1928.

[2] See list of literature cited, at end of paper.

of North Carolina, but the material development of the "Open Land" did not take place until recently. In 1916 a company was formed, known as the Virginia-Carolina Farms Company, which took over a large section of the peninsula. The primary purpose was the development of the property for colonization purposes. Because of war conditions the title to the land came into the hands of the East Coast Land Company, and subsequently as a gift into the hands of the University of Chicago. Extensive drainage operations were begun in 1917, and canals and lateral ditches were dug, designed to carry in 24 hours a depth of three-quarter inches of water from the acreage assigned to them. No attempt was made to provide for the control of the water table or to meet the specific requirements for water of different crops and peat soil conditions. Three sub-districts were established, each with a separate outlet to sea level. A map giving an outline of the system of ditches and the boundary of the "Open Land" is shown in figure 4.

In 1923 a drainage district was organized, comprising 4575 acres of the "Open Land" area. Agricultural operations began about that time. Several well-constructed houses, barns, and roads were built, and experimental plots and test wells were established. Flooding, drought, fires, and other unfavorable field conditions defeated the efforts of the settlers, and in 1926 the district, reported to represent an investment of $700,000, was abandoned. Today the area is visited only by hunters. The buildings (Fig. 1) are unoccupied and falling into decay. They could serve for laboratory purposes, if permission were obtained to use them in peat investigations by different workers and from different angles at various seasons during the year.

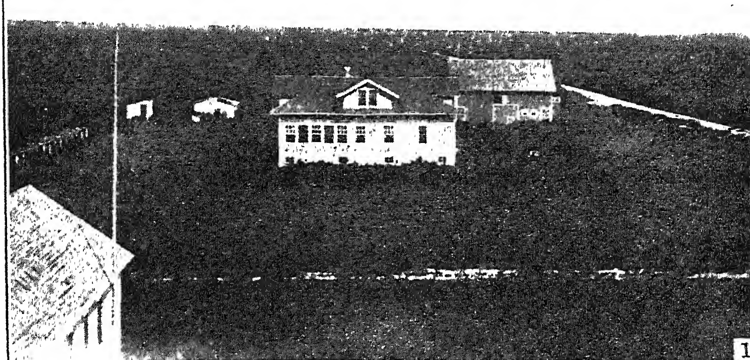
Surface Vegetation

The area represents a striking example of the Coastal Plain evergreen shrub-bog. The present consocies of the bog proper is dominated by *Cyrilla racemiflora*. The subdominants are *Zenobia cassinifolia, Pieris nitida, Chamaedaphne calyculata, Smilax laurifolia, Tamala pubescens*. Minor elements which may here and there attain sub-

Fig. 1.—General view of "Open Land" peat area showing "Buck Head Lodge" and adjoining buildings, now abandoned. Photographed by B. W. Wells, September 10, 1928.

Fig. 2.—Succession of *Solidago fistulosa* (light middle distance), initiated by fire; break in tree-line at right shows where fire came through. Photographed by B. W. Wells, September 10, 1928.

Fig. 3.—Regeneration of *Pinus serotina* in "bay" shrubs near ditches. Photographed by B. W. Wells, September 10, 1928.



1

2

3

dominance are *Anchistea virginica, Aronia arbutifolia, Ilex lucida, Gordonia lasianthus, Kalmia angustifolia, Magnolia virginica, Pinus serotina.* Such a shrub-bog is known locally as a "pocosin," or "bay." (6).

The *Cyrilla,* which elsewhere may grow to 15 feet in height, is, together with the other shrubs, here only 1.5 to 4 feet tall. Fire, which sweeps the area every 2 to 5 years, keeps the shrub cover low. *Pinus serotina,* the only tree on the area, has been almost completely removed by fire from the central body of the bog, giving the locality its distinctive open aspect.

Locally where, because of high wind or other causes, the fire has been intense and has eliminated or weakened the shrubs, an evanescent herbaceous consocies will initiate the new sere or subsere. The chief dominants involved are *Solidago fistulosa, Erechtites hieracifolia, Arundinaria macrosperma, Andropogon capillipes* (*A. virginicus* on drained areas), and *Amphicarpon amphicarpon* (Fig. 2). In this connection it is of interest to note that *Campulosus aromaticus,* the grass-sedge bog dominant of mineral soil (7), is entirely absent; there appears to be no tendency, no matter how frequent the fire, toward the establishment on the peat soils of the relatively permanent grass-sedge bog associes with its host of species bearing showy flowers.

The drainage factor in a period of five years has not brought about any change in the shrub complex; the perfectly drained zone immediately next the ditches shows no response. The question of how much this is due to competition and how much to a possible lag effect of certain bog soil conditions must remain for further study.

The vegetation of the environing transition areas, where drainage conditions are improved and the peat is thinner or entirely absent, is characteristically dominated by *Ilex glabra* with much *Pinus serotina* of fair size. *Arundinaria* is also prominent in certain places along the borders. The pocosin pine mentioned constitutes the encircling forest, extending around the area with but one break on the east side.

Concerning the life form of the shrub-bog plants attention should be directed to the fact that the leaves of the shrubs are without exception some slight variant of the simple ovate or elliptic type of foliar organ and uniformly possess a leathery texture, suggesting xeric structure. The necessary tests, however, have not been made to prove them bog xerophytes.

The old field succession in the drained area is the familiar Coastal Plain *Syntherisma-Eupatorium* (*capillifolium*), *Andropogon* (*virginicus, capillipes*) sequence. *Solidago fistulosa* may be prominent also in the middle stage. On an area which was tile-drained *Eupatorium capilli-*

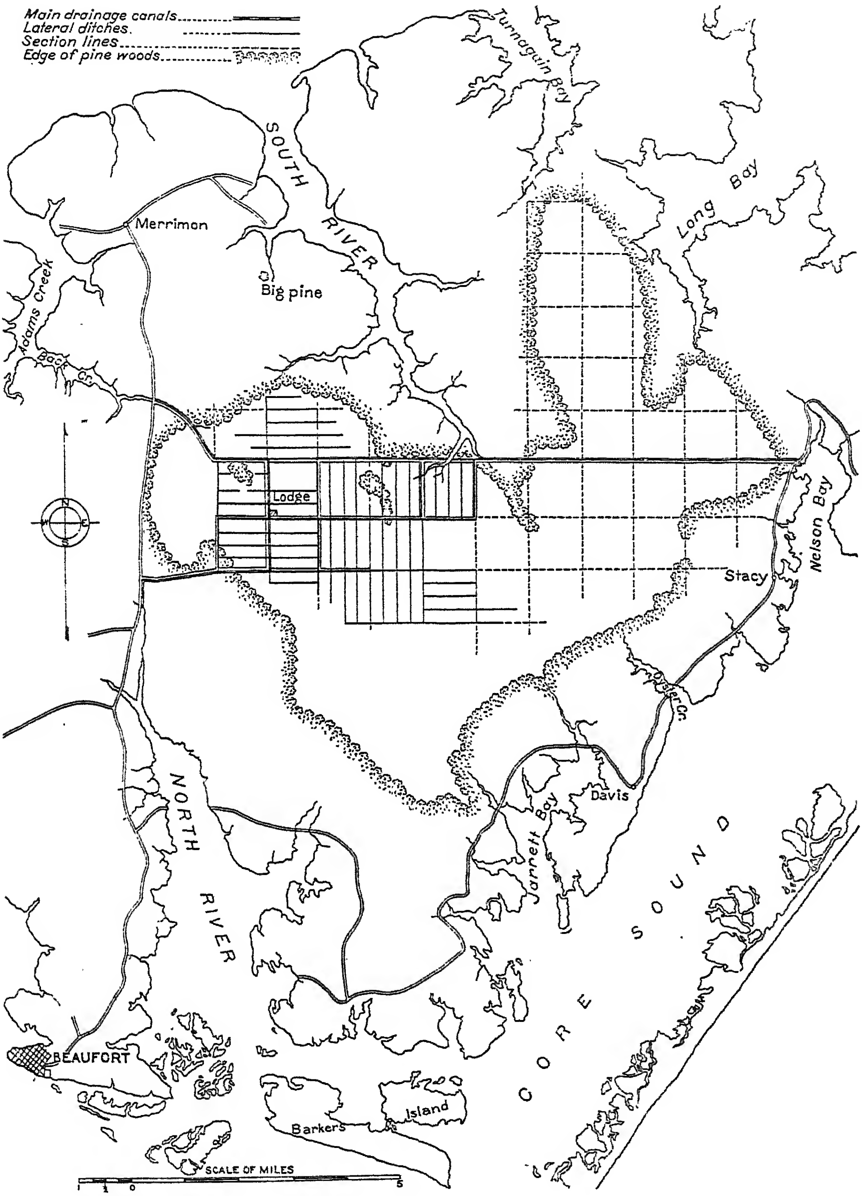


Fig. 4.—Map showing location of the "Open Land" peat area in Carteret County, North Carolina, and its present system of drainage ditches. From field data of the author, prepared by the Division of Agricultural engineering, U. S. Department of Agriculture.

folium was found in complete dominance, while the adjoining area, drained only by ditches, showed *Solidago fistulosa* as the dominant.

PROFILE FEATURES

The examination of peat profiles was made according to a method fully described in earlier publications (1). The American peat-sounding instrument was used and a number of characteristics were noted on the exposed cross-sections of pits and ditches, such as composition of peat material, color, odor, texture, structure, inclusions, degree of decomposition, moisture content, distribution of roots, thickness of peat layers, and nature of mineral subsoil. It would be out of place to discuss these here in more detail. In the preliminary field work much that is important may have escaped attention, nevertheless the more outstanding facts of the stratigraphy and age of the "Open Land" peat area can be summarized as follows:

The profile series over the entire area appear to be essentially the same. A cross section about $1\frac{1}{4}$ miles east of the main office building (Buck Head Lodge) may be taken as typical of the Beaufort type of peat land:

SECTION OF "OPEN LAND" PEAT TAKEN $1\frac{1}{4}$ MILES EAST OF BUCK HEAD LODGE.

(1) 0–$\frac{1}{2}''$ thin superficial layer of dry, gray, leafy litter from heath-shrubs and ferns, on

$\frac{1}{2}$–$1\frac{1}{2}''$ black charred, dry, loose, granular, hard organic material with woody fragments from heath-shrubs burned over about 3 years ago, on

$1\frac{1}{2}$–$4''$ reddish brown to dark brown, largely decomposed woody debris, moist, granular, mellow, frequently lumpy at lower level, embedded in a dense network of rootlets, grading into

4–11″ reddish brown, largely decomposed, moist lumpy to cloddy heath-shrub peat, with well-preserved, living woody roots and underground stems of heath-shrubs.

11–18″ same with an open network of fine roots and rootlets from surface vegetation; grading sharply into

(2) 18–28″ black, sticky, wet, rather compact and impermeable, amorphous sedimentary peat; without roots or fibrous components, occasionally woody fragments are present and tap roots of pocosin pine (*P. serotina*) growing at the surface.

28–29″ black, sticky, sedimentary peat with an admixture of gray gritty sand which increases in thickness in an eastward direction; rests on

(3) 29–33″ logs, roots, and stumps *in situ* of white cedar (*Chamaecyparis thyoides*), embedded in a yellowish brown, finely fragmented to granular woody peat, partly decomposed; portions of it chaffy when dry, free from sand or silt, moist, rather compact.

33–38″ same with an admixture of fibrous material from roots of herbaceous plants; increasingly sandy at lower level.

38–45″ yellow-brown, finely divided organic debris with large amounts of fine sand; contains roots and rootlets.

(4) 45–48″ gray fine sand with small amounts of organic debris, somewhat mottled and cross-bedded; varying in thickness and sharply demarked from

48″ gray to bluish gray, compact sand. There is a layer of sea shells about 3 to 4 feet below the bluish-gray sand (i.e. 8 feet below the surface). The shell bed consists nearly entirely of species living at the present time. It is obviously a littoral marine formation.

Stratigraphic Analysis and Age

The sequence of peat layers, as shown in the stratigraphic section above, affords a basis for inferring the physical conditions which prevailed during the origin and formation of the "Open Land" peat area.

(A) The plain on which the area of peat was formed is the lowest well defined member of a series of coastal terrace plains that front the Atlantic Ocean from Maryland and Virginia to Florida. The terraces are believed to represent sea floors exposed by diastrophic movements of the coastal region dating from late Pliocene time to the present (3). The highest terraces, being older and farther inland, were the first to emerge, while the lower, which are younger and nearer to the ocean, emerged relatively recently. Stephenson in his account of the coastal plain of North Carolina (3) has given the name Pamlico to the youngest of these terraces, and Matson and Sanford in discussing the Pleistocene of Florida (5) regard the lowermost terrace, on which the Everglades are located, as a portion of the Pensacola terrace. Both are emerged sea-bottoms floored with a bed of sea shells.

During the period of elevation of the shell layer (an off-shore deposit) the coarse sand material of shore currents was laid down on it. The upward movement, it is clear, continued until this sand stratum was elevated above sea level. The sharpness of the transition from the coarse sand to the thin layer of bluish clay-like fine sand, deposited unconformably, suggests that after the coarse sand was laid down the locality was still close enough to the sea for tidal inflow, and subject to the influence of silt-laden fresh and brackish waters. It is believed that later a beach ridge or low sand dunes, built up by wind activity, marked the temporary position of the shore during the emergence of the sea-bottom. Back of it lay a lagoon, upon which wind-blown sand gradually accumulated. The organic remnants of a marsh vegetation occurring thereon are still present, but not in the form of

any well-marked layer of matted fibrous sedge or reed peat. The ancient marsh was overflowed from time to time by turbid sheets of water, causing the water to deposit its excess of silt and leaving partly decomposed branches, bark, and roots embedded in a yellowish brown fine sand.

(B) Soon after the depression of the sea, or the uplift of the land, shrubs and trees attained dominance early in the history of the formation of the "Open Land." Typical profile sections show practically a pure stand of *Chamaecyparis thyoides* as the one dominant. The brown layer of peat, derived from the white cedar swamp, is little else than a tangled mass of roots, partially decayed stumps, and fallen logs in a good state of preservation. Less resistant plant remains falling to the ground decayed to a larger degree, but the accumulation was faster than decomposition; the permanent wetness of the peat material, induced by its high water-holding capacity and by poor drainage conditions, excluded air and the organisms which cause the final disappearance of all organic matter. How many years elapsed during this time interval can not be stated with certainty. The thickness of the woody layer of peat, when more or less saturated with water, varies between 1½ and 2 feet, but estimates based upon the rate of accumulation of various kinds of plant remains would not be very reliable.

(C) The woody material from the restricted white cedar swamp continued to accumulate until the process was interrupted by a renewed sinking of the land. Once more the sea rose, probably owing to the return of cool waters from melting ice sheets in the north. The land came to rest at an altitude several feet below its present level. As a result of the subsidence the area of white cedar swamp became exposed at first to inundation by flood waters containing gritty sand and silt. The presence of ripple-marks in the corresponding level of the marginal sand ridges, exposed along the northern highway, would indicate that shallow water conditions existed at first. This was followed by a prolonged period of high water. A high sand barrier-reef or dunes, whose crest must still have been considerably above sea level at that time, probably marked the position of the shore during this stage of coastal subsidence. The partial submergence undoubtedly not only choked the lower courses of the streams and creeks with their forests of cypress and gum, but extended the river swamps and the quiet water of ponds considerably inland.

The composition of the plant community of deep and shallow sur-

face waters must have been similar to that of aquatic habitats of today. Submersed forms and plants with floating leaves were prominent, among them *Potamogeton, Castalia, Nymphaea, Myriophyllum, Philotria, Lemna,* and others. This was the period during which the jet-black to bluish-black, amorphous, mud-like layer of sedimentary peat accumulated. The botanical composition of the constituent vegetation has now almost completely disappeared. In texture and color the layer is quite uniform where tested, except for the partially decayed tap-roots found here and there derived from a later growth of pocosin pines. The character of the recognizable plant remains gives evidence also that the deposition occurred in fresh water and was uniform over a considerable period of time during which the coastal region remained essentially stable.

A further point, of more practical bearing, should be added here. The finely divided, largely decomposed sedimentary organic debris shrinks under conditions of drainage, and consequently becomes compacted and relatively impermeable to the subsequent passage of water, air, or salts. Roots of plants pass through it with difficulty. Below this layer the peat materials are wet; above it the precipitation water is stagnant and the surface soil is saturated. Periods of drought, on the other hand, bring a complete reversal of conditions, characterized by long periods of low soil-water content in the surface layer, and fires as a major factor in the destruction of crops and cultivated peat soil.

It is interesting to note that both in stratigraphic position and physical characteristics this middle layer of macerated, sedimentary peat is closely paralleled by and strictly comparable with that in the Everglades at Okeelanta, Florida, outlined in a table to show the geologic time range of peat deposits in the United States and Europe (2).

(D) The next event appears to have been a renewed emergence (differential uplift?) of the land, at least of small amount, which probably proceeded from south to north, and culminated perhaps only a few thousand years ago. As the surplus of the surface waters of inland ponds drained away, shrubs such as *Cyrilla* quickly assumed complete dominance in the wetter habitat, later sharing it with typical heaths and bay shrubs. This community of evergreen, broad-leafed plants occupied the area and accumulated peat to the present level. In wet places cushions of sphagnum mosses accompanied the shrubs, but at no time were they present in sufficient abundance to form a layer of moss peat. The fact should be pointed out also that formerly *Pinus serotina* was not prominent in the "Open Land," for no reproduction

of pines takes place of itself under wet conditions, while the shrubs predominate in dense stands. With the introduction of drainage the pocosin pine is establishing itself to a marked degree (Fig. 3), but fires are reducing its dominance. The size of the hummocks of charred peat in the extensive, fire-swept area shows that about 10 to 16 inches of the top layer of heath-shrub peat has been burned off.

Conclusions

The most striking results brought out by the study of the present surface vegetation and the stratigraphic features are the natural history of the origin and formation of the "Open Land" peat area. The characteristics observed in the type profile section are briefly described and important relationships are pointed out between the middle layer of sedimentary peat and its effects upon surface vegetation, drainage, fire, and cultural operations.

It is hoped that future work will make considerable progress along lines of (1) intensive ecological vegetation studies (in coöperation with the State College of Agriculture), (2) differentiation of profile units and series of profile analyses to furnish data regarding the physical properties and chemical composition of the different layers of peat, their microbiological population, the alteration and changes in peat layers related to vegetation, drainage, fire, and cultivation, (3) records of consequent shrinkage and fluctuations of the water supply (in coöperation with the U. S. Bureau of Public Roads, Division of Agricultural Engineering). It is contemplated to run lines of level, connected to sea-datum. They will include areas of brackish marsh, heath shrub, natural reforestation and abandoned, cultivated peatland. Permanent plots will be established in drained and undrained sections for periodical observations to be made in the spring and fall by a party of investigators using the main office building as headquarters.

Information of that character has not been available for earlier observers and is of far-reaching importance in peat investigations as well as an aid to a broad and impartial judgment on questions of improving the utilization and management of peat areas in North Carolina. The results of such studies are not wholly limited to this state, however, but are intended to serve to clarify the fundamental peat problem presented for comparison by other states of the Atlantic Coastal Plain.

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(3). W. B. Clark, B. L. Miller, L. W. Stephenson, and others. *The Coastal Plain of North Carolina.* N. C. Geol. Econ. Surv. **3**: 1912.

(4) A. Lefferts, H. C. Lay, and C. W. Lewis. *Carteret County: economic and social.* Univ. N. C. Extension Bull. 5: no. 13. 1926.

(5). G. C. Matson and S. Sanford. *Geology and ground waters of Florida.* U. S. Geol. Surv. Water-supply Paper 319. 1913.

(6) B. W. Wells. *Plant communities of the coastal Plain of North Carolina and their successional relations.* Ecology **9**: 230–242. 1928.

(7) —— *A southern upland grass-sedge bog: an ecological study.* N. C. Exp. Station Techn. Bull. 32. 1928.

BOTANY.—*Additional Costa Rican mosses.*[1] By Edwin B. Bartram, Bushkill, Pennsylvania. (Communicated by William R. Maxon.)

Since the studies on Mr. Standley's Costa Rican mosses were completed,[2] additional collections from Costa Rica have come in, principally from Prof. Manuel Valerio, of San José, which not only supplement Mr. Standley's excellent series in many interesting and important particulars but also add a number of new species to the apparently inexhaustible moss flora of this country. There seems to be scarcely any limit to the opportunities for constructive bryological effort in Costa Rica, and the success which has attended Professor Valerio's activities can hardly fail to serve as a stimulus to any one with an inclination in this direction, who now and then has a chance to explore the more inaccessible mountain areas.

In the following enumeration there are 28 species (marked with an asterisk) which are not represented in Mr. Standley's collections. Among these the following seem to be unrecorded from Central America: *Anoectangium condensatum, Chorisodontium speciosum, Syrrhopodon Gaudichaudii, Pseudosymblepharis circinata, Orthodontium pellucens, Leskeodon pusillus, Haplohymenium triste, Erythrodontium squarrosum,* and *Ctenidium malacodes.* Four species, *Dicranum costaricense, Pseudosymblepharis Bartrami, Leptodontium Valerianum,* and *Stenodictyon sericeum,* are described here for the first time, and the remaining 91 of the total of 123 species listed are additional records which have a decided interest from the viewpoint of local distribution.

[1] Received December 1, 1928.

[2] Contr. U. S. Nat. Herb. **26**: 51–114. *Fig. 1–39.* Oct. 31, 1928.

Specimens of all the collections have been deposited with the United States National Museum, excepting those of Mr. Lankester which are in the Herbarium of the Field Museum of Natural History, Chicago.

SPHAGNACEAE

SPHAGNUM RECURVUM Beauv.

Pejivalle, Sept. 14, 1927, *Valerio* 51.

FISSIDENTACEAE

FISSIDENS ASPLENIOIDES (Sw.) Hedw.

Piedra Blanca, Oct. 9, 1927, *Valerio* 87; El Gallito, Province of Heredia, Oct. 28, 1928, *Valerio* 190, 196.

FISSIDENS OERSTEDIANUS C. M.

Tablazo, Jan. 18, 1928, *Valerio* 131.

DICRANACEAE

AONGSTROEMIA JAMAICENSIS C. M.

Volcán de Barba, June 26, 1926, *Valerio* 12; Sept. 5, 1926, *Valerio* 29.

*MICRODUS BARBENSIS (Ren. & Card.) Broth.

Tablazo, Oct. 30, 1927, *Valerio* 92, 94.

DICRANELLA STANDLEYI Bartr.

Volcán de Barba, July 29, 1926, *Valerio* 20.

CAMPYLOPUS INTROFLEXUS (Hedw.) Mitt.

Tablazo, July 27, 1927, *Valerio* 34, 36, 37; Volcán de Barba, *Valerio* 6; Cerros de Candelaria, Aug. 15, 1926, *Valerio* 28; El Gallito, Province of Heredia, Oct. 28, 1928, *Valerio* 184.

CAMPYLOPUS SUBLEUCOGASTER (C. M.) Jaeg. & Sauerb.

Las Cóncavas, Nov. 2, 1927, *C. H. Lankester*.

CAMPYLOPUS HOFFMANNI (C. M.) Ren. & Card.

Volcán de Barba, *Valerio* 47.

Campylopus filifolius (Hsch.) Mitt. var. **longifolius** (Bartr.), comb. nov.

The Costa Rican collections referred to *C. Harrisi* and the var. *longifolius* Bartr.[3] are evidently forms of *C. filifolius*, as Mr. R. S. Williams has suggested, but they are readily distinguished from the type by the much longer comal leaves (up to 15 or 20 mm. long) and by the strongly pitted basal cells. The variation is well marked in the material available. In addition to the collections previously cited the following have since been received: La Hondura, June 5, 1926, *Valerio* 3; La Palma, April 30, 1928, *Valerio* 149.

In this variety, as well as in the type form, the leaves are clearly dimorphous. Those of the comal tufts are widely spreading with flexuose points,

[3] *Loc. cit.* 64.

the blade incurved about 1.5 mm. up from the base then channelled above, costa long-excurrent, blade gradually narrowed upward and 1 or 2 cells wide for some distance below its termination, serrulate on the margin only a short way down, alar cells forming large inflated auricles extending to the costa. The stem leaves between the comose tufts are appressed and closely sheathing, abruptly narrowed from a clasping base about 1.5 mm. long to a short filiform point about 3 times as long, which is bordered by the narrow blade almost to the apex, conspicuously decurrent, alar cells inconspicuous or none.

CAMPYLOPUS PORPHYREODICTOS (C.M.) Mitt.

Tablazo, July 27, 1927, *Valerio* 36a; Tablazo, Aug. 5, 1928, *Valerio* 156.

CAMPYLOPUS FALCATULUS Bartr.

Tablazo, Jan. 18, 1928, *Valerio* 128.

PILOPOGON GRACILIS (HOOK.) Brid.

San Ignacio, Aug. 4, 1928, *Valerio* 165; Tablazo, Oct. 30, 1927, *Valerio* 98; El Gallito, Province of Heredia, Oct. 28, 1928, *Valerio* 181.

METZLERELLA COSTARICENSIS (C. M.) Broth.

Volcán de Barba, *Valerio* 22.

HOLOMITRIUM TEREBELLATUM C. M.

Volcán de Barba, June 6, 1926, *Valerio* 13; El Gallito, Province of Heredia, Dec. 20, 1927, *Valerio* 114.

*CHORISODONTIUM SPECIOSUM (Hook. & Wils.) Broth.

El Gallito, Province of Heredia, Dec. 20, 1927, *Valerio* 107.

The plants in this collection are indistinguishable from authentic specimens of this species from Ecuador and Bolivia, all of which have the costa indistinct above and the upper leaf cells irregularly in two layers. *Dicranoloma setaceum* Bartr.[4] shows the same leaf structure, but the stems are shorter and more densely foliate and the leaves are strongly falcate-secund, with flexuose points. If not a form of *C. speciosum*, it is evidently very closely related and should take the name of **Chorisodontium setaceum** (Bartr.), comb. nov.

DICRANUM FRIGIDUM C. M.

Volcán de Barba, Aug. 14, 1927, *Valerio* 119, 120.

Dicranum costaricense Bartr., sp. nov. Fig. 1, A–K.

Dioicous. Male plants (?) numerous, up to 1.5 cm. high, simple or branched, attached to tomentum or older leaves; flowers terminal; perigonal leaves from a clasping base gradually narrowed to a stout serrulate point, the costa short-excurrent; antheridia abortive or supra-mature, only a few shrunken fragments observed. Stems robust, up to 10 cm. high, densely and more or less interruptedly foliate to the base, tomentose throughout, in loose

[4] *Loc. cit.* 70.

deep tufts, yellowish green at the tips, fulvous brown below; leaves flexuose-spreading all around or rather appressed between the comose tufts, up to 10 or 12 mm. long, ovate-lanceolate, gradually narrowed to a long grooved point, the margin and costa remotely dentate about one-fourth of the way down; costa short-excurrent, indistinct in the lower half, about one-third the width of the leaf just above the alar cells, lightly ribbed on the back, in cross-section about the middle showing a median row of 6 or 7 guide cells with stereid bands above and below, the dorsal band much wider than the ventral with the outer cells differentiated; basal leaf cells rectangular with strongly pitted lateral walls, 3 or 4 rows on the margins very narrow but hardly forming a distinct border; alar cells conspicuous, forming an inflated, reddish brown group extending to the costa, the median and upper cells obliquely rhomboidal with rather incrassate straight or scarcely pitted walls. Sporophyte unknown.

TYPE: La Palma, Costa Rica, altitude 1,500 meters, April 30, 1928, *Valerio* 148.

The robust, interruptedly foliate stems, relatively broad costa with but a few remote teeth on the back, straight-walled upper leaf cells and the conspicuous alar group filling the entire leaf base reflect a combination of characters that readily distinguish this species from *D. frigidum.*

SCHLIEPHACKEA METERIOIDES (R. S. Williams) Broth.

La Palma, April 30, 1928, *Valerio* 12.

DICRANOLOMA BRITTONAE Bartr.

La Palma, April 30, 1928, *Valerio* 141.

The above number is identical with the type collection from Cerros de Zurquí, but like that is absolutely sterile. Several points in the description of *Dicranum Goudotii* Hampe suggested a relationship with the Costa Rican moss; but no specimen of Hampe's species could be located in the Mitten Herbarium at the New York Botanical Garden, and from the absence of any notes it seemed evident that Mitten's description had been copied from the original source without any critical study of the type collection. Mr. H. N. Dixon has very kindly compared the two plants and reports as follows: "Compared with *Dicranoloma Brittonae* Bartr., *D. Goudotii* is shorter, with considerably denser foliation, leaves less crisped when dry; base narrower and also subula, which is much finer. Nerve $1\frac{1}{2}$ times as wide at base and ill defined. Upper cells smaller and less incrassate, as also are the alar cells. Subula not fragile, scarcely undulate when dry." In the absence of any further particulars it would seem that *D. Brittonae* is specifically distinct, but whether it properly belongs in *Dicranoloma*, *Dicranum*, or *Schliephackea* is still an open question. The leaves are very similar to those of *Schliephackea meterioides* in outline and areolation, but the margin is only obscurely denticulate above and the longer point is strongly spirally twisted when dry.

LEUCOLOMA SERRULATUM Brid.

El Gallito, Province of Heredia, Dec. 20, 1927, *Valerio* 112.

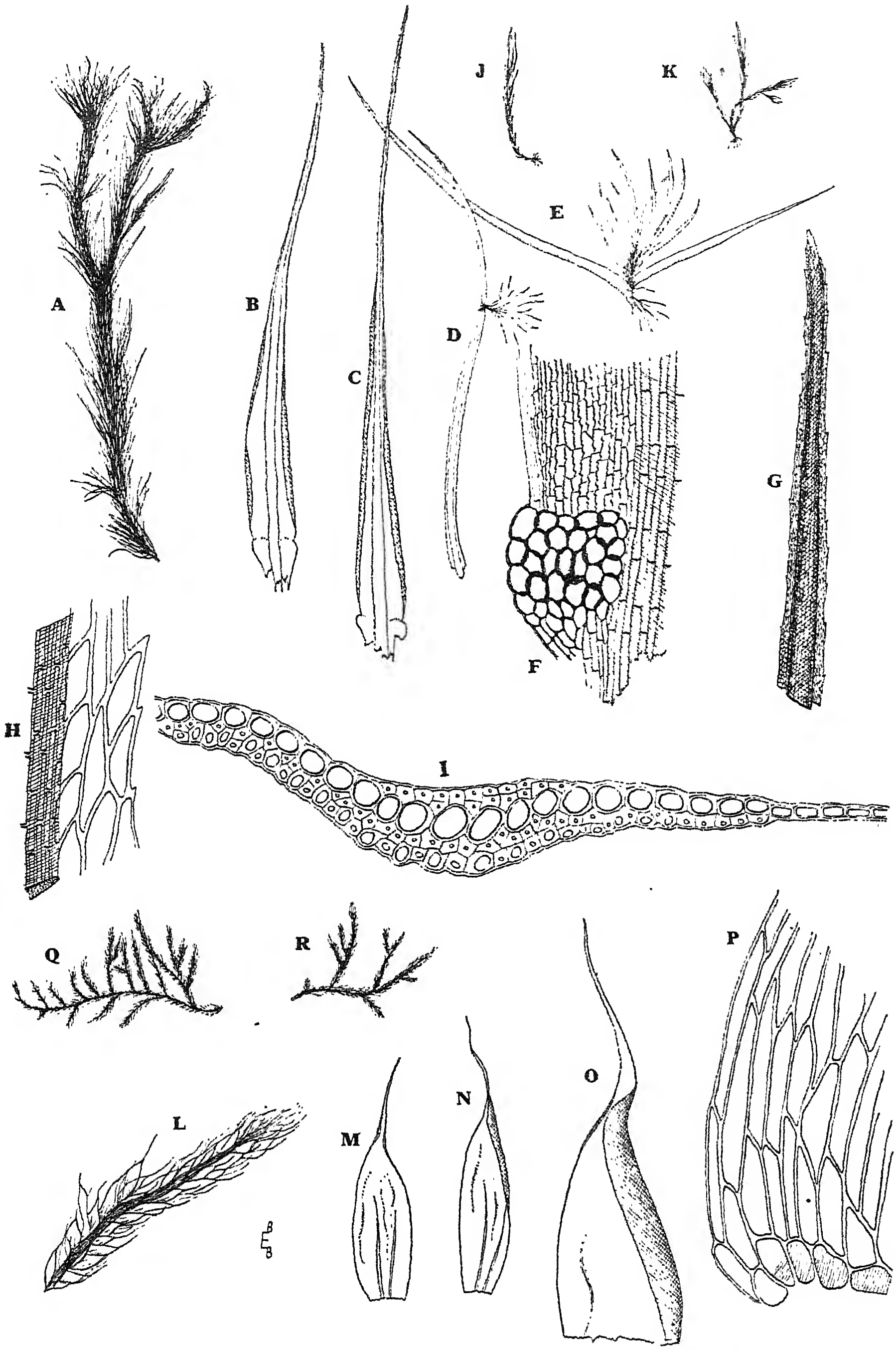

Fig. 1. A-K. *Dicranum costaricense* Bartr., sp. nov.—A, plant $\times \frac{2}{3}$; B, C, leaves $\times$ 8; D, E, leaves with young male plants attached $\times$ 8; F, one side of leaf base $\times$ 56; G, leaf apex $\times$ 56; H, part of upper leaf blade $\times$ 300; I, cross-section of costa about mid-leaf $\times$ 300; J, K, mature male plants $\times 1\frac{1}{3}$.

L-R. *Stenodictyon sericeum* Bartr., sp. nov.—L, tip of branch $\times$ 8; M, N, leaves $\times$ 23; O, leaf apex $\times$ 56; P, basal angle of leaf $\times$ 300; Q, R, plants $\times 1\frac{1}{3}$.

LEUCOBRYACEAE

OCTOBLEPHARUM ALBIDUM (L.) Hedw.

Pejivalle, Sept. 4, 1927, *Valerio* 47; San José, Jan. 20, 1928, *Valerio* 135; San Ignacio, Aug. 4, 1928, *Valerio* 158; Parismina, July 26, 1928, *Valerio* 168.

OCTOBLEPHARUM MITTENII Jaeg.

Pejivalle, Sept. 4, 1927, *Valerio* 46.

CALYMPERACEAE

*SYRRHOPODON GAUDICHAUDII Mont.

El Gallito, Province of Heredia, Dec. 20, 1927, *Valerio* 111.

This species has been known from the West Indies and northern South America, but the above collection seems to be the first from Central America.

SYRRHOPODON INCOMPLETUS Schwaegr.

Pozo Azul de Pirris, *C. H. Lankester.*

SYRRHOPODON LYCOPODIOIDES (Sw.) C. M.

El Gallito, Province of Heredia, Oct. 28, 1928, *Valerio* 198.

POTTIACEAE

ANOECTANGIUM EUCHLORON (Schwaegr.) Mitt.

Cervantes, June 30, 1928, *Valerio* 161; Cebadilla, Nov. 15, 1927, *Valerio* 101; Piedra Blanca, Province of San José, Oct. 21, 1928, *Valerio* 175.

*ANOECTANGIUM CONDENSATUM Schimp.

Piedra Blanca, Province of San José, Oct. 21, 1928, *Valerio* 176.
Previously known only from Mexico.

Pseudosymblepharis Bartrami Thér. in litt., sp. nov. Fig. 2, J–Q.

Dioicous. Antheridial flowers not seen. Plants in deep dense tufts, yellowish green above, brown below; stems about 2.5 cm. high, simple or sparingly branched, closely matted together in the lower half with reddish tomentum; leaves erect with crispate points when dry, erect-spreading with incurved points when moist, very fragile and mostly broken off about half way down, up to 5.5 or 6 mm. long, carinate, gradually narrowed to a linear-lanceolate point from an erect, ovate, lightly clasping base; costa relatively slender, 60–70μ wide toward the base, tapering upward and short-excurrent, papillose on the ventral surface, nearly smooth on the back, in cross-section about mid-leaf showing a median row of 4 large guide cells with stereid bands on both sides and two large cells on the ventral surface; lower basal cells linear to rectangular, irregular, hyaline and smooth, gradually becoming narrower upward with thick pellucid walls, strongly pitted toward the costa, nearly straight toward the margins, gradually becoming shorter and papillose toward the top of the leaf base, several rows of elongated hyaline cells extending upward on the margins but not forming a distinct border; upper leaf cells rounded-quadrate or transversely oval, obscure, rather incrassate, densely papillose on both sides. Sporophyte unknown.

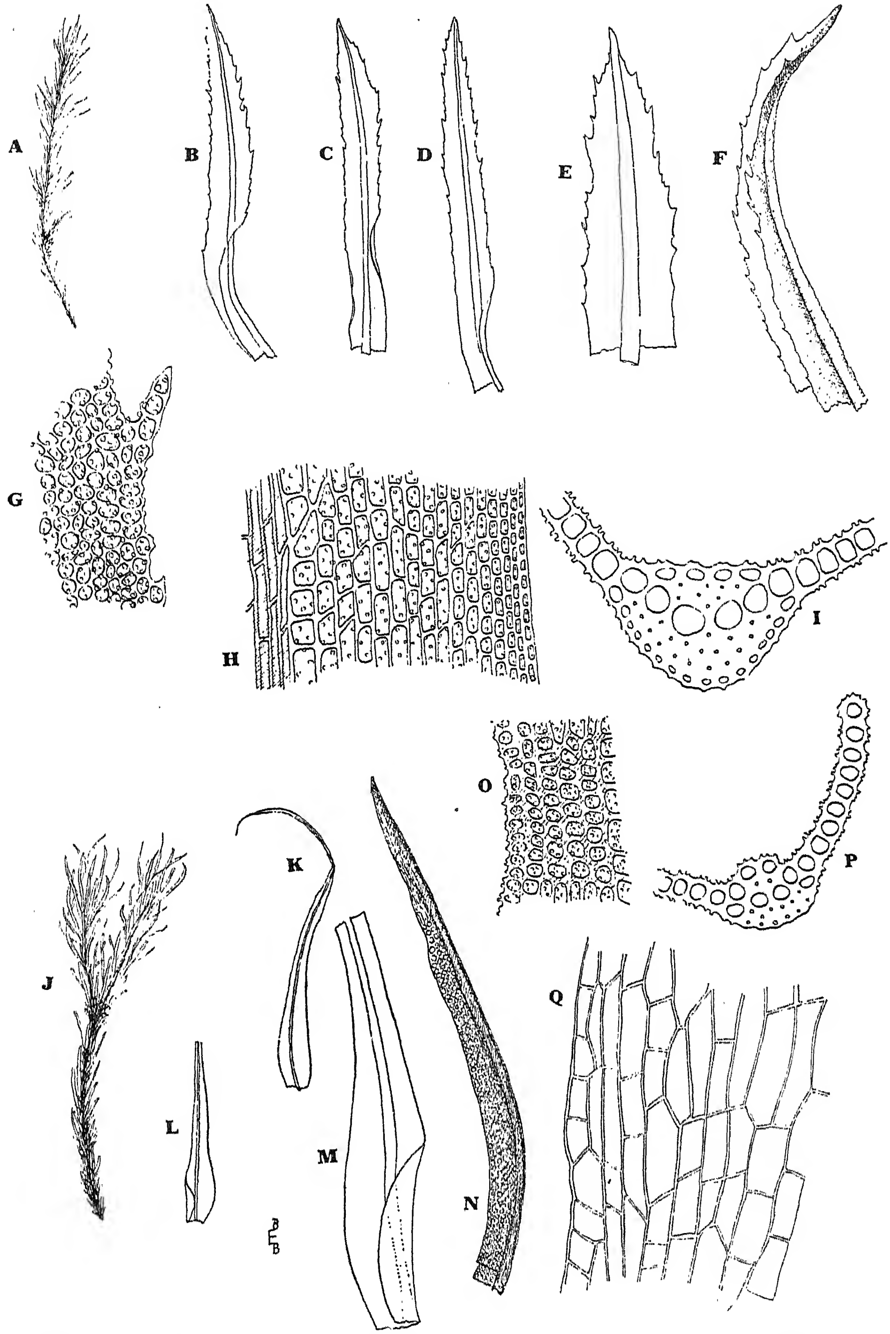

Fig. 2. A-I. *Leptodontium Valerianum* Bartr., sp. nov.—A, moist plant × $\frac{2}{3}$; B, C, D, leaves × 23; E, F, apices of leaves × 56; G, upper leaf cells and margin × 320; H, one side of leaf base and part of costa × 320; I, cross-section of costa about mid-leaf × 320.
J-Q. *Pseudosymblepharis Bartrami* Thér., sp. nov.—J, moist plant × $\frac{2}{3}$; K, leaf × 8; L, broken leaf × 8; M, lower part of leaf × 23; N, apex of leaf × 106; O, upper leaf cells and margin × 320; P, part of cross-section of leaf about half-way down × 320; Q, basal cells and margin × 320.

TYPE: On log, Cerros de Zurquí, northeast of San Isidro, Province of Heredia, Costa Rica, altitude 2,000–2,400 meters, March 3, 1926, *Paul C. Standley* 50701.

According to M. Thériot this plant is distinguished from *S. circinata* (Schimp.) Broth., to which it was referred in the list of Mr. Standley's Costa Rican mosses,[5] by the more erect leaves, especially when moist, the less conspicuously sheathing leaf base, which is very gradually narrowed upward, and the more slender nerve. These differences, stressed by M. Thériot, have been verified by a further study of the material and may be supplemented by the brittle quality of the leaf points, which is so marked that in most of the plants only a few entire leaves can be found.

*PSEUDOSYMBLEPHARIS CIRCINATA (Schimp.) Broth.

Piedra Blanca, Province of San José, Oct. 21, 1928, *Valerio* 176a.

In contrast with the preceding collection these plants, segregated from the tufts of *Anoectangium condensatum*, no. 176, are identical with specimens from Mexico and Jamaica.

Leptodontium Valerianum Bartr., sp. nov. Fig. 2, A–I.

Dioicous? Antheridial flowers unknown. Plants slender, in compact tufts, yellowish green above, pale brown below. Stems about 2.5 cm. long, erect or ascendent, branched from near the base, sparingly radiculose below and rather densely matted with reddish tomentum in the lower third; leaves about 2 mm. long, incurved-crispate when dry, flexuose-spreading when moist, linear-lanceolate, carinate; margin flat, crenulate with projecting papillae, denticulate below, coarsely and irregularly serrate in the upper half; costa about 60μ wide just above the base, tapering upward and percurrent or ending just below the apex, in cross-section near the middle showing a median row of about 6 large cells with stereid bands above and below, the outer layer of cells on both sides clearly differentiated: upper leaf cells rounded, 7–8μ in diameter, thin-walled, papillose and rather obscure, toward the base oblong, about 20μ long by 5μ wide, with more incrassate, pellucid walls, shorter and subquadrate toward the margins. Sporophyte unknown.

TYPE: Piedra Blanca, Province of San José, Costa Rica, altitude 2,400 meters, Oct. 9, 1927, *Valerio* 86.

The narrow, plane-margined leaves, coarsely serrate in the upper half, readily distinguish this plant from *L. filescens* (Hampe) Mitt. In gross appearance it suggests *Hymenostylium curvirostre*, but under a microscope or even with a hand lens the strongly serrate leaf margin is, of course, very distinctive. In the absence of fruiting plants the element of uncertainty with regard to the generic position of the species is ever-present, but its affinities are certainly more clearly with *Leptodontium* than with any of the allied genera. Professor Valerio has shown a welcome interest in the mosses of Costa Rica and it is a privilege to be able to associate his name with this unique plant.

[5] *Loc. cit.* 74.

LEPTODONTIUM SUBGRACILE Ren. & Card.

Volcán de Barba, July, 1926, *Valerio* 27; Volcán de Barba Aug. 14, 1927, *Valerio* 117.

LEPTODONTIUM ULOCALYX (C. M.) Mitt.

Volcán de Barba, June 23, 1926, *Valerio* 21.

HYOPHILA TORTULA (Schwaegr.) Hampe.

Cebadilla, Nov. 15, 1927, *Valerio* 21.

*DIDYMODON CAMPYLOCARPUS (C. M.) Broth.

Piedra Blanca, Province of San José, Oct. 9, 1927, *Valerio* 90.

*BARBULA COSTARICENSIS Ren. & Card.

Piedra Blanca, Province of San José, Oct. 9, 1927, *Valerio* 90a.

FUNARIACEAE

FUNARIA CALVESCENS Schwaegr.

Escazú, *Valerio* 42, 43; San José, July 31, 1927, *Valerio* 45; Pejivalle Sept. 4, 1927, *Valerio* 50; Guarco, Province of Cartago, *Rubén Torres Rojas* 259.

SPLACHNACEAE

*TAYLORIA MORITZIANA C. M.

La Palma, April 30, 1928, *Valerio* 142.

BRYACEAE

*ORTHODONTIUM PELLUCENS (Hook.) Bry. Eur.

La Palma, April 30, 1928, *Valerio* 137, 138; El Gallito, Province of Heredia, Oct. 28, 1928, *Valerio* 197.

The distribution of this genus is typically austral and Prof. Valerio's collections add a new and interesting element to the Costa Rican moss flora. The species has been collected previously in Colombia and Ecuador.

WEBERA PAPILLOSA (C. M.) Broth.

El Gallito, Province of Heredia, Oct. 28, 1928, *Valerio* 187.

BRACHYMENIUM SPATHULIFOLIUM Ren. & Card.

Tablazo, July 27, 1927, *Valerio* 39.

BRACHYMENIUM SYSTYLIUM (C. M.) Jaeg.

Volcán de Barba, July 27, 1926, *Valerio* 21; Piedra Blanca, Province of San José, Oct. 21, 1928, *Valerio* 180.

*BRACHYMENIUM BARBAE-MONTIS Ren. & Card.

Cebadilla, Nov. 15, 1927, *Valerio* 100.

Acidodontium megalocarpum (Hook.) Ren. & Card.

Volcán de Irazú, May, 1928, *C. H. Lankester.*

*Bryum coronatum Schwaegr.

Pozo Azul de Pirris, *C. H. Lankester.*

Bryum argenteum L.

San José, Oct. 30, 1927, *Valerio* 99.

Bryum rosulicoma Ren. & Card.

Volcán de Barba, Sept. 5, 1926, *Valerio* 32; Piedra Blanca, Province of San José, Oct. 21, 1928, *Valerio* 171.

RHIZOGONIACEAE

Rhizogonium Lindigii Hampe.

El Gallito, Province of Heredia, Dec. 20, 1927, *Valerio* 110.

Rhizogonium spiniforme (L.) Bruch.

La Palma, April 30, 1928, *Valerio* 143.

AULOCOMNIACEAE

Leptotheca costaricensis Thér.

El Gallito, Province of Heredia, Oct. 28, 1928, *Valerio* 183.

BARTRAMIACEAE

*Breutelia jamaicensis (Mitt.) Broth.

Piedra Blanca, Oct. 9, 1927, *Valerio* 88.

Breutelia tomentosa (Sw.) Schimp.

El Gallito, Province of Heredia, Dec. 20, 1927, *Valerio* 115; Piedra Blanca, Oct. 21, 1928, *Valerio* 172.

ORTHOTRICHACEAE

Macromitrium apiculatum (Hook.) Brid.

Orrabal, Province of Cartago, July 15, 1927, *Rubén Torres Rojas* 250; Guarco, Province of Cartago, Sept. 15, 1927, *Rubén Torres Rojas* 253.

Macromitrium cirrhosum (Hedw.) Brid.

Cartago, Aug. 20, 1927, *Rubén Torres Rojas* 258; Tablazo, Oct. 30, 1927, *Valerio* 97; Tablazo, Jan. 18, 1928, *Valerio* 127; Reventazón, *C. H. Lankester.*

Macromitrium Tonduzii Ren. & Card.

Volcán de Barba, July 9, 1926, *Valerio* 25.

Macromitrium subcirrhosum C. M.

Volcán de Barba, July, 1926, *Valerio* 33; El Gallito, Province of Heredia, Dec. 20, 1927, *Valerio* 106.

MACROMITRIUM PALMENSE R. S. Williams

Volcán de Barba, June 26, 1926, *Valerio* 2.

MACROMITRIUM LONGIFOLIUM (Hook.) Brid.

La Hondura, June 5, 1926, *Valerio* 15.

MICROMITRIUM LAMPROCARPUM (C. M.) Par.

San Ignacio, April 3, 1928, *Valerio* 150; San Marcos, June 17, 1927, *Valerio* 44; Cervantes, June 30, 1928, *Valerio* 160.

HELICOPHYLLACEAE

*HELICOPHYLLUM TORQUATUM (Hook.) Brid.

Cebadilla, Nov. 15, 1927, *Valerio* 103.

RHACOPILACEAE

RHACOPILUM TOMENTOSUM (Sw.) Brid.

San José, Oct. 12, 1927, *Valerio* 83a.

PRIONODONTACEAE

PRIONODON LUTEOVIRENS (Tayl.) Mitt.

Volcán de Barba, July 14, 1927, *Valerio* 54, 66.

PRIONODON FUSCOLUTESCENS Hampe.

El Gallito, Province of Heredia, Dec. 20, 1927, *Valerio* 108; Volcán de Barba, July 29, 1926, *Valerio* 26.

PRIONODON DENSUS (Sw.) C. M.

La Palma, June 5, 1926, *Valerio* 16; Cerro de Gallito, June, 1926, *Valerio* 7; Volcán de Barba, July, 1926, *Valerio* 50; El Gallito, Province of Heredia, Dec. 20, 1927, *Valerio* 109, 124.

PRIONODON DENSUS (Sw.) C. M. var. MEXICANUS (Thér.) Bartr.

La Carpintera, June, 1926, *Valerio* 1; Volcán de Barba, May 9, 1926, *Valerio* 51.

PTEROBRYACEAE

PTEROBRYOPSIS MEXICANA (Schimp.) Fleisch.

El Gallito, Province of Heredia, Dec. 20, 1927, *Valerio* 105.

PTEROBRYUM DENSUM (Schwaegr.) Hsch.

La Palma, *Valerio* 26; El Gallito, Province of Heredia, Dec. 20, 1927, *Valerio* 118.

METEORIACEAE

*SQUAMIDIUM LEUCOTRICHUM (Tayl.) Broth.

Volcán de Barba, July 9, 1926, *Valerio* 25; Tablazo, July 27, 1927, *Valerio* 55.

The above numbers are identical with *Türckheim* 7141 from Guatemala, and also with a collection from Guadeloupe by Père Duss under the name of *Pilotrichella longipila* Schimp. There is apparently nothing to separate the latter plant from *S. leucotrichum* and it would seem, therefore, that Schimper's name should be reduced to synonymy.

PILOTRICHELLA RIGIDA (C. M.) Besch.

Pejivalle, Sept. 4, 1927, *Valerio* 77.

PILOTRICHELLA PULCHELLA Schimp.

La Carpintera, *Valerio* 5; San Ignacio, Aug. 4, 1928, *Valerio* 163; El Gallito, Province of Heredia, Dec. 20, 1927, *Valerio* 122.

PILOTRICHELLA FLEXILIS (Sw.) Jaeg.

Volcán de Barba, June, 1926, *Valerio* 6; Piedra Blanca, Oct. 9, 1927, *Valerio* 89; Tablazo, Jan. 18, 1928, *Valerio* 129, 132; Cervantes, June 30, 1928, *Valerio* 162; Volcán de Barba, July 14, 1927, *Valerio* 69.

PAPILLARIA NIGRESCENS (Sw.) Jaeg.

Parismina, July 26, 1928, *Valerio* 166.

PAPILLARIA DEPPEI (Hsch.) Jaeg.

San Ignacio, April 3, 1928, *Valerio* 152.

PAPILLARIA IMPONDEROSA (Tayl.) Broth.

Volcán de Barba, July 29, 1926, *Valerio* 33.

A careful comparison of the series of Costa Rican collections with the type material of *P. imponderosa* (Tayl.) Broth., from Ecuador, fails to reveal any tangible or constant distinctions in leaf characters, and there is no doubt in my mind that *P. oerstediana* (C. M.) Jaeg. should, as suggested by Mr. R. S. Williams,[6] be reduced to a synonym of this species.

METEORIOPSIS PATULA (Sw.) Broth.

Pejivalle, Sept. 4, 1927, *Valerio* 75.

PHYLLOGONIACEAE

PHYLLOGONIUM FULGENS (Sw.) Brid. var. GRACILE Ren. & Card.

La Palma, *Valerio* 11; San Ignacio, April 3, 1928, *Valerio* 151.

PHYLLOGONIUM VISCOSUM (Beauv.) Mitt.

Volcán de Barba, July, 1926, *Valerio* 53; La Palma, June, 1926, *Valerio* 4.

NECKERACEAE

CALYPTOTHECIUM TURGESCENS Broth. & Thér.

El Gallito, Province of Heredia, Dec. 20, 1927, *Valerio* 121; Piedra Blanca, Oct. 9, 1927, *Valerio* 85.

[6] Bull. N. Y. Bot. Gard. 6: 240. 1909.

Porotrichum longirostre (Hook.) Mitt.

Volcán de Barba, July 14, 1927, *Valerio* 61.

LEMBOPHYLLACEAE

*Porotrichodendron substolonaceum (Besch.) Broth.

Volcán de Barba, July 14, 1927, *Valerio* 64.

HOOKERIACEAE

*Leskeodon pusillus (Mitt.) Broth.

El Gallito, Province of Heredia, Oct. 28, 1928, *Valerio* 185, 195.

This genus is well represented in the Antilles and a single species has been described from Mexico, but the present collections seem to establish the first record for Central America.

Cyclodictyon rubrisetum (Mitt.) Broth.

Volcán de Barba, Sept. 5, 1926, *Valerio* 52.

Hookeriopsis subfalcata (Hampe) Jaeg.

El Gallito, Province of Heredia, Oct. 28, 1928, *Valerio* 189.

Hookeriopsis falcata (Hook.) Jaeg.

El Gallito, Province of Heredia, Dec. 20, 1927, *Valerio* 116.

Hookeriopsis crispa (C. M.) Jaeg.

El Gallito, Province of Heredia, Oct. 28, 1928, *Valerio* 200.

Stenodictyon sericeum Bartr., sp. nov. Fig. 1, L–R.

Dioicous? No antheridial flowers found. Plants in thin, silky, lustrous mats, yellowish green; stems creeping, up to 2.5 cm. long, irregularly branched, showing dark red through the delicate leaves when moist, sparingly radiculose in the older parts, about 1 mm. wide with the rather flattened leaves; leaves erect-spreading, oblong-lanceolate, up to 1.6 mm. long, concave, lightly plicate, rather gradually narrowed to an almost capillary, entire or remotely denticulate, flexuose hair point; margin plane below, usually strongly inflexed at the base of the acumen, entire below the point; costae double, faint, ending a little above the middle, smooth on back; leaf cells elongate, prosenchymatous, smooth, somewhat more lax toward the base, usually a single row of short irregular brownish cells at the insertion. Sporophyte unknown.

Type: La Palma, Costa Rica, altitude 1,500 meters, April 30, 1928, *Valerio* 146.

This species is clearly distinguished from *S. nitidum* (Mitt.) Jaeg., of Ecuador, by the more slender stems and the long hair points of the leaves. The latter character and the essentially entire leaves serve to distinguish it equally clearly from *S. saxicola* R. S. Williams, of Bolivia.

Harpophyllum aureum (Beauv.) Spruce

La Palma, June, 1926, *Valerio* 20; La Palma, April 30, 1928, *Valerio* 140.

Brotherus has, by implication, suggested a similar thought by ignoring *S. loxense*, *S. galipense*, and several other closely related types in the second edition of *Die Pflanzenfamilien*, and there is little doubt that a critical revision of this group, with a large series of collections for comparison, will be necessary before the real relationship and value of the various forms can be cleared up.

*SEMATOPHYLLUM COCHLEATUM (Broth.) Broth.

Pejivalle, Sept. 4, 1927, *Valerio* 49.

ACROPORIUM PUNGENS (Sw.) Broth.

Reventazón, *C. H. Lankester;* La Palma, April 30, 1928, *Valerio* 139.

TAXITHELIUM PLANUM (Brid.) Mitt.

Pozo Azul de Pirris, *C. H. Lankester.*

HYPNACEAE

HYPNUM POLYPTERUM Mitt.

Volcán de Barba, July 29, 1926, *Valerio* 31, 32, 36; Cervantes, June 30, 1928, *Valerio* 159.

*CTENIDIUM MALACODES C. M.

La Palma, April 30, 1928, *Valerio* 144.

ISOPTERYGIUM CYLINDRICARPUM Card.

Cerros de Candelaria, Aug. 15, 1926, *Valerio* 43.

MICROTHAMNIUM THELISTEGUM (C. M.) Mitt.

El Gallito, Dec. 20, 1927, *Valerio* 123.

MICROTHAMNIUM REPTANS (Sw.) Mitt.

Tablazo, Oct. 30, 1927, *Valerio* 95; El Gallito, Dec. 20, 1927, *Valerio* 123.

MICROTHAMNIUM LEHMANNII Besch.

San Ignacio, April 3, 1928, *Valerio* 153; La Palma, April 30, 1928, *Valerio* 136.

MICROTHAMNIUM MINUSCULIFOLIUM C. M.

La Palma, April 30, 1928, *Valerio* 147.

MICROTHAMNIUM LANGSDORFII (Hook.) Mitt.

Cerros de Candelaria, Aug. 15, 1926, *Valerio* 42.

POLYTRICHACEAE

CATHARINAEA HIRTELLA Ren. & Card.

El Gallito, Oct. 28, 1928, *Valerio* 193.

CATHARINAEA UNDULATIFORMIS (Ren. & Card.) Broth.

Tablazo, July 27, 1927, *Valerio* 35.

*POGONATUM BARBANUM Ren. & Card.

Tablazo, July 27, 1927, *Valerio* 38; Tablazo, Oct. 30, 1927, *Valerio* 104.

POGONATUM ROBUSTUM Mitt.

Volcán de Barba, June 22, 1926, *Valerio* 10, 14.

*POGONATUM TORTILE (Sw.) Beauv.

La Palma, July 24, 1926, *Valerio* 24.

POLYTRICHUM ANTILLARUM Rich.

Cerros de Candelaria, Aug. 15, 1926, *Valerio* 31; La Hondura, June 5, 1926, *Valerio* 5.

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GEOLOGY.—*A mastodon skeleton near San Francisco Bay.*[1] Eliot Blackwelder, Stanford University.

Well preserved remains of mastodons are sufficiently uncommon to merit the publication of definite records concerning them, especially when the geologic surroundings have been studied. In June, 1927, parts of a mastodon skeleton were discovered at the bottom of a pit that was being dug for a cistern about 2.3 miles west of Menlo Park station, which in turn is about 28 miles southeast of San Francisco. The bones which were recovered and are now in the museum of the Department of Geology at Stanford University consist of a molar tooth, three sections of a tusk and some fragments of ribs and other bones. A second tooth was found but was not given to the University. The enamel of the teeth was in such excellent condition that it was not even discolored, but the other bones were rather fragile. Although it is possible that the entire skeleton was present, the cost of digging it out would under the circumstances have been prohibitive.

The section exposed in the pit was as follows:

	Feet
6. Black clayey soil	4
5. Mottled drab and russet joint clay	11
4. Olive clay with many small chalky nodules	1
3. Olive-drab sandy clay	5
2. Coarse brown sand and very fine gravel; clean and free from iron oxide	1
1. Light green clay	1+

The bones were found embedded in the lowest layer of clay (1) and were partly covered by the sand (2). The impervious nature of the clay probably accounts for the good condition of the skeleton.

[1] Received December 5, 1928.

The location of this find is on a lot belonging to Mr. John Lebord, about one-half mile east of the intersection of the Woodside highway and the foothill road. It is in the plain formed by the coalescent alluvial fans that fringe San Francisco Bay. Physiographic evidence indicates that the entire deposit is of Recent and late Pleistocene age.

In this connection it may be of interest to recall that the depth and general position of the mastodon skeleton is about the same as that in which a human skull was found on the Stanford campus a few years previously.[2] The suggestion of contemporaneity is not to be lightly dismissed.

The tooth from this collection was submitted to Dr. W. D. Matthew, of the University of California, for examination. He found that it resembled rather closely the teeth of *Mastodon merriami* and *M. matthewi* Osborn—two species, of late Miocene and early Pliocene age, which have recently been segregated in a distinct genus, *Miomastodon*, by Dr. H. F. Osborn. As this genus is very imperfectly known the reference of the tooth to either of the above species can not be made with much confidence. The occurrence of the skeleton in the unconsolidated and entirely undeformed strata of the alluvial plain indicates strongly that the age is probably not greater than late Pleistocene. In that part of the California Coast Ranges all Pliocene formations have been strongly folded and faulted and even the early Pleistocene deposits have been disturbed and much eroded. The clear implication of the physiographic evidence is believed to be more significant in this case than the general resemblance of the teeth to those of a genus not yet known from post-Pliocene formations.

GEOLOGY.—*The Cretaceous section in Black Mesa, northeastern Arizona.*[1] JOHN B. REESIDE, JR. and ARTHUR A. BAKER, U. S. Geological Survey.

Black Mesa is an elevated area of Cretaceous rocks forming the central part of a well defined structural basin in northeastern Arizona. It constitutes a large part of the Hopi Indian Reservation in Navajo and Coconino Counties; on the northern and eastern sides it extends a short distance into the Navajo Reservation and therefore enters

[2] BAILEY WILLIS. *Out of the long Past.* Stanford Cardinal **32**: 8-11. 1922.

[1] Received December 18, 1928. Published with the permission of the Director, U. S. Geological Survey.

Apache County also. The geology of the mesa is of particular interest because it is one of the areas composing the westernmost line of deposits of the Cretaceous of the Interior Province. During the summer of 1928 the writers had opportunity to see much of the southern, and particularly the eastern and northern margins and were enabled to examine in some detail the section at the north end of the mesa just south of Kayenta. The previous reports on the geology of the mesa, briefly noted below, and our own observations justify the assumption that the results obtained on the northern margin will hold for the whole area. As they are somewhat at variance with the earlier views it has seemed worth while to record them.

Previous Observations

In 1861 Newberry[2] recorded the first description of the southern side of Black Mesa, assigning the lower [Dakota (?)] coal-bearing rocks to the Jurassic on the basis of the associated plant fossils and the overlying beds to the Cretaceous on the basis of both fossil invertebrates and plants. What seems to be the Mancos shale of later reports is assigned a thickness of 250 feet, and invertebrates are listed which would be called today *Prionotropis woolgari* Mantell, *Inoceramus labiatus* Schlotheim, and *Gryphaea newberryi* Stanton.

Howell[3] in 1875 also noted the section of coal-bearing rocks near the Hopi pueblos on the southern margin of Black Mesa, describing the succession as 100 to 300 feet of cream-colored sandstone and shale resting on 300 to 500 feet of dark shale, resting in its turn on soft white sandstones of Jurassic age.

In 1910 Darton[4] quoted brief descriptions from Newberry and Howell, and assigned the rocks of Black Mesa somewhat indefinitely to Dakota and later beds.

In 1911 Campbell and Gregory[5] compared the coal-bearing rocks of Black Mesa with those of the region near Gallup, New Mexico, and described them as including the Dakota sandstone and probably the Mesaverde formation, with a thin Mancos shale between. They

[2] J. S. Newberry. *Report upon the Colorado River of the West, explored in 1857–58 by Lieut. J. C. Ives. Pt. 3, Geological Report:* 82–83, 129–131. 1861.

[3] E. E. Howell. *Report on the geology of portions of Utah, Nevada, Arizona, and New Mexico.* U. S. Geogr. Geol. Surv. W. 100th Mer. **3**: 279. 1875.

[4] N. H. Darton. *A reconnaissance of parts of northwestern New Mexico and northern Arizona.* U. S. Geol. Surv. Bull. 435: 54. 1910.

[5] M. R. Campbell and H. E. Gregory. *The Black Mesa coal field, Arizona.* U. S. Geol. Surv. Bull. 431. 1911.

suggested that the Mancos shale owed its small thickness, as compared with the Mancos shale of San Juan Basin, either to actual lack of material or to a progressive change in the upper part whereby sandstones appeared westward at lower and lower horizons. The thickness of the so-called Dakota is given as from nothing to 70 feet, the Mancos shale as 300 feet, and the Mesaverde as probably not exceeding 500 feet.

In 1917 Gregory,[6] in a description of a large region including Black Mesa, added much detail, and interpreted the section in the mesa as containing Dakota sandstone, Mancos shale, and Mesaverde formation. The so-called Dakota sandstone was accepted as ranging in thickness from a few feet to 300 feet or more and containing, in addition to the usual sandstones, beds of conglomerate, shale, and impure coal. The greater thickness was found on the western side of the mesa. The Mancos shale was shown to have a thickness of from 490 to 620 feet where complete sections could be measured, the thickness increasing from southwest to northeast. The Mesaverde formation was shown to vary much in thickness, owing to the fact that it is the highest formation over much of the mesa and has been eroded to a varying degree. At the northeastern prominence, Yale Point, the formation included 745 feet of sandstone and shale, with coal in the lowermost part and again in a zone above the middle, and a marine horizon 200 feet above the base. This thickness is probably near the maximum remaining on the mesa. Fossils cited in the three formations: from the so-called Dakota, various plants; from the Mancos, *Exogyra laeviuscula* Roemer, *Ostrea* sp., *Inoceramus labiatus* Schlotheim in the lower part, and *Prionotropis* sp. near the middle; from the Mesaverde, *Ostrea pellucida* Meek and Hayden, *Inoceramus proximus* Tuomey, and *Gervillia*, said to be of Montana age, in the marine zone at Yale Point.

Darton[7] in 1925 accepted for the rocks of Black Mesa Gregory's classification as Dakota sandstone, Mancos shale, and Mesaverde formation, quoting from Gregory the data given.

Reagan[8] in 1925 gave a brief general discussion of the geology of Black Mesa and the surrounding region. For the Cretaceous he used

[6] H. E. Gregory. *Geology of the Navajo Country.* U. S. Geol. Surv. Prof. Paper 93: 68–79. 1917.

[7] N. H. Darton. *A resumé of Arizona geology.* Univ. Ariz. Bull. 119 (Geol. 3): 143–155. 1925.

[8] Albert B. Reagan. *Late Cretacic formations of Black Mesa, Arizona.* Pan-Amer. Geol. **44**: 285–294. 1925.

the following divisions, based apparently in large part on the section near Kayenta: Dakota sandstone, seldom exceeding 120 feet in thickness. Tununk shale and sandstone, probably exceeding 240 feet and containing *Gryphaea newberryi* Stanton and *Exogyra columbella* Meek. Mancos shale, equivalent to the part of the Mancos of other authors above the Tununk sandstone and exceeding 500 feet in thickness. Mesaverde sandstone, 350 feet thick and containing many thick seams of coal. Lewis or Masuk shale, 20 to 30 feet thick. Pictured Cliffs sandstone, 25 feet thick. Zilhlejini coal formation, 200 feet thick, bearing fresh and brackish water fossils and forming the surface rocks over much of the central part of the mesa. The fossils named are *Ostrea glabra* Meek and Hayden, *Ostrea soleniscus* Meek, and *Modiola laticostata* White. Reagan's Zilhlejini formation is overlain by shales and sandstones and with them was said to be a possible equivalent of the Fruitland and Kirtland formations of New Mexico. All the later rocks were spoken of as of Laramie age. In a later article[9] Reagan briefly described again the Mesaverde of Black Mesa and figured the three species found in his Zilhlejini formation. The present writers have examined the section near Kayenta and believe that in the lower part of his section Reagan has confused slumped materials with those in place and that his Tununk division does not exist. Between the Dakota(?) and the so-called Mesaverde there is only one shale body, as correctly described by Gregory[10] for the nearby Lolomai Point, in the lower part of which occur the fossils assigned by Reagan to his Tununk shale. The remainder of Reagan's section is considered in a later paragraph.

Section near Kayenta, Arizona

As just stated above, the writers examined the section, except for the uppermost part of the coal-bearing rocks, in the margin of Black Mesa, 4 miles south of Kayenta and 4 miles east of Lolomai Point. A number of collections of marine fossils were made that offer a check on the older collections from the Mancos shale, and one from the coal-bearing rocks that indicates a greater age than usually assigned to them. The thicknesses given are only approximate but the relative order of the beds is assured, as the rocks are completely exposed in a

[9] Albert B. Reagan. *Extension of Cretacic Laramie formation into Arizona.* Pan-Amer. Geol. **46**: 193–194. 1926.

[10] H. E. Gregory, *Op. cit.*, p. 74.

steep slope at the locality where the examination was made. The section with its fossils is as follows:

SECTION OF CRETACEOUS ROCKS IN BLACK MESA, 4 MILES SOUTH OF KAYENTA, ARIZONA

Mesaverde formation of previous reports:	
Sheer wall of massive reddish-brown sandstone capping the edge of the mesa and visible for many miles along it	250
Gray to yellow sandstone with minor shale and coal beds, not examined in detail	350
Massive buff sandstone, medium grained; no fossils observed	50
Platy buff, fine grained, thin bedded sandstone and gray shale, forming a weak unit. The sandstone layers yielded *Inoceramus deformis* Meek, *I. undabundus* Meek, *I.* aff. *I. stantoni* Sokolow, *Ostrea congesta* Conrad, *Ostrea* sp., *Anomia subquadrata* Stanton, *Cardium pauperculum* Meek, *Tellina* cf. *T. subalata* Meek, *Legumen* sp. (n. sp.?), *Mactra* sp., *Dentalium* sp. (n. sp.?), *Turbonilla* cf. *T. coalvillensis* Meek, *Turitella* cf. *T. whitei* Stanton, *Baculites* cf. *B. codyensis* Reeside, *Placenticeras* aff. *P. pseudoplacenta* Hyatt	75
Grit and fine quartz conglomerate, gray to yellow, resting on an irregular base; no fossils observed	20
Coal in two thin beds in carbonaceous shale	40
Massive yellow sandstone; no fossils observed	50
Mancos shale of previous reports:	
Interbedded light gray soft sandstone and sandy shale forming a transition zone; no fossils observed	100
Dark gray to black shale, much of it flaky; very thin, discontinuous calcareous fine grained brownish sandstones at a few horizons above the middle. A layer at 300 feet above the base of the unit contained an abundance of *Prionotropis woolgari* Mantell of Meek, and a few individuals of *Ostrea* sp., *Anomia?* sp., *Mactra?* sp., and fish scales; one 250 feet above the base, *Prionotropis woolgari;* and one 200 feet above the base, *Globigerina* sp.	350
Light bluish-gray calcareous shale containing a few very thin bands of dark limestone; basal 10 feet sandy. At the top were found *Inoceramus labiatus* Schlotheim, *Ostrea* sp., *Globigerina* sp., and a large fish vertebra; at 120 feet above the base of the unit, *Ostrea* sp., *Inoceramus* sp., *Globigerina* sp., *Baculites gracilis* Shumard, *Metoicoceras* sp.; at 20 feet above base, *Inoceramus labiatus* Schlotheim, *Ostrea* sp., fish scales; at 10 feet above base *Liopistha* (*Psilomya*) *concentrica* Stanton, *Gryphaea newberryi* Stanton; at the base of the unit, *Ostrea soleniscus* Meek and Hayden. *Inoceramus labiatus* was noted at many horizons in this unit but the crumbly shale matrix prevented collection	150
Interbedded thin, impure coal beds and gray sandy shale, a transition unit	10
Dakota (?) sandstone:	
Brown to gray coarse sandstone above, coal and gray shale near middle, brown sandstone and conglomerate below	100
Morrison formation (McElmo of authors):	
Gray-white to greenish-white sandstone and red and gray shales.	

Age of the Deposits

The Dakota(?) sandstone of Black Mesa has yielded so few paleontologic data that one may say at best only that it is probably equivalent to the beds widespread in western Colorado, Utah, and western New Mexico, and now usually designated Dakota(?) sandstone to express the likelihood that it is not an exact equivalent of true Dakota sandstone and the possibility that part of it may be of Lower Cretaceous age and part of Upper Cretaceous age. There may also have been an interval between the deposition of these parts not now represented by sediments.

The shale which has been called Mancos contains an equivalent of the Benton shale only, and is but a small part of the typical Mancos shale of the northern San Juan Basin in Colorado. It is essentially the Turonian of the European classification. Fossils distinctive of the highest part of the Benton, such as *Prionocyclus wyomingensis* Meek and *Scaphites warreni* Meek and Hayden, were not observed by the writers and have not been reported by others, but this zone may well be represented by the relatively barren and probably nonmarine zone at the top of the shale and in the base of the overlying formation. The occurrence of *Ostrea soleniscus* Meek and Hayden and *Gryphaea newberryi* Stanton near the base of the so-called Mancos agrees with the known range of these species. *Exogyra laeviuscula* Roemer, reported in this zone by Gregory, is also in agreement. The presence of *Inoceramus labiatus* Schlotheim and *Metoicoceras* sp. at somewhat higher levels accords with their usual position and indicates that the lower fourth of the shale is equivalent to the Graneros shale and Greenhorn limestone of the Great Plains region east of the Rocky Mountains. A second fourth yielded no fossils. The zone containing *Prionotropis woolgari* (Mantell) of Meek, constituting the fourth above the middle, agrees with the lower part of the Carlile shale of the Plains (upper Benton), and, as noted above, there is still room for an equivalent of the remainder of the Carlile in the uppermost fourth. A shale formation corresponding closely in position and fauna to the so-called Mancos shale of Black Mesa is known in a belt that includes the Kaiparowits Plateau, the Colob Plateau, the western margin of the Wasatch Plateau, and the Coalville region of Utah.[11]

[11] E. M. Spieker and J. B. Reeside, Jr. *Upper Cretaceous shore-line in Utah.* Bull. Geol. Soc. Amer. **37**: 429–438. 1926. G. B. Richardson. *The Upper Cretaceous section in the Colob Plateau, southwest Utah.* This Journ. **17**: 464–475. 1927. H. E. Gregory and R. C. Moore. *The Kaiparowits Region.* U. S. Geol. Surv. Prof. Paper (In press).

The so-called Mesaverde formation has not yielded a large fauna. The fossils found by the writers in the 75-foot unit 110 feet above the base of the formation are of Niobrara age and the containing beds correspond to some part of the middle Mancos of San Juan Basin and are considerably older than the typical Mesaverde of the same Basin. They are Coniacian, in terms of the European classification. Gregory records from a similar horizon in his section at Yale Point[12] the Montana species *Ostrea pellucida* Meek and Hayden, *Inoceramus proximus* Tuomey, and *Gervillia* sp. It is the writers' belief that these are misidentifications of species belonging to the same fauna as those found near Kayenta. For the higher beds Reagan records, as noted in page 33, *Ostrea glabra* Meek and Hayden, *O. soleniscus* Meek, and *Modiola laticostata* White. *O. glabra* of Reagan is a simple type that might be a variant of the species to which it is assigned, but might equally well belong to some other simple species and means little for correlation. If the identification of *O. soleniscus* is valid, and the published figure certainly lends credibility to it, the containing beds (Zilhlejini formation of Reagan) are not younger than Niobrara, for the latest known occurrence of the species is with Niobrara forms in beds that correspond in position and fauna to the "Mesaverde" of Black Mesa. These beds, like the equivalent of the "Mancos," occur in the Kaiparowits Plateau, the Colob Plateau, etc. The writers suggest, though the published figure is not very clear, that Reagan's *Modiola laticostata* is *M. multilinigera* Meek of Colorado age. A collection made by Gregory (U. S. Geological Survey loc. no. 11642), labelled, "Chilchinbito, massive sandstone capping Black Mesa," and apparently not included in any published record, contains *Inoceramus stantoni* Sokolow, *Ostrea* sp., *Mactra* sp., and *Volutoderma* sp. (large, undescribed). This fauna, from the highest unit of our section and in or above Reagan's Zilhlejini formation, is of Niobrara age and would support the fossils reported by Reagan. It is the opinion of the writers, therefore, that not only the lower part of the so-called Mesaverde of Black Mesa but the upper part also is of Niobrara age, and that there is no warrant for correlating any part of it with the typical Mesaverde and later formations of San Juan Basin or with the units recognized in the Henry Mountains of southern Utah.

Conclusions

The Cretaceous section of Black Mesa resembles that of Kaiparowits Plateau, Colob Plateau, the western side of the Wasatch Plateau, and

[12] H. E. Gregory. *Op. cit.*, p. 78.

Coalville, Utah, rather than that of San Juan Basin or the Henry Mountains.

The lowest of the three major divisions, the Dakota (?) sandstone, is assignable only in a general way to a pre-Benton age.

The middle major division, the Mancos shale of previous reports, is of Benton age, and represents only a small part of the typical Mancos shale.

The highest major division, the Mesaverde formation of previous reports, is of Niobrara age, and represents a part of the typical Mancos shale, and is considerably older than any beds to which the name Mesaverde could be applied, even in an elastic usage of the term.

PALEOBOTANY.—*An* Anacardium *in the lower Eocene of Texas.*[1] EDWARD W. BERRY, Johns Hopkins University.

The genus *Anacardium* contains 8 or 10 species of shrubs and trees in the existing flora. Outside of cultivation these are confined to the American wet tropics. The leaves are rather characteristic and the fruits are exceedingly so.

Saporta, long ago, proposed a form genus, *Anacardites,* for fossil leaves supposed to belong to the family Anacardiaceae, but which could not be referred with certainty to any of the existing genera of the family. About a score of species have been referred to *Anacardites,* but these, with the single exception to be noted presently, resemble those of genera such as *Mangifera, Anaphremium,* and *Spondias,* and are not like the leaves of *Anacardium* itself.

The exception mentioned is *Anacardites balli* Berry[2] from the Jackson Eocene (Fayette sandstone) in Brazos and Grimes counties, Texas. Although it can not be conclusively demonstrated, I believe that this form is closely related to *Anacardium,* and this identification is rendered more probable by the discovery of the seed described below.

In 1924 I described the silicified fruits of an *Anacardium* from the Oligocene of Peru, and these are practically identical with the existing Cashew nut. They are present in great abundance associated with other fruits and seeds at a locality known as Belen, about 6 miles southeast of Puenta Pariñas, Department of Piura, Peru, and I had the pleasure of visiting the locality and making additional collections during the summer of 1927. The Peruvian material shows in an un-

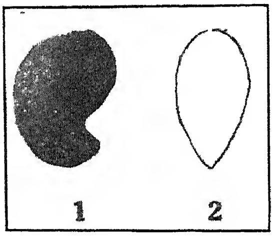
[1] Received November 23, 1928.

[2] E. W. BERRY. U. S. Geol. Surv. Prof. Paper 92: 177. *Pl. 62, fig. 7.* 1924.

mistakable manner the features of the nut (seed), the shell and its secretory lining.

At the time *Anacardium peruvianum* Berry[3] was described I had similar specimens from Colombia, but did not know the exact locality. This I now know was the valley of Santo Ecce Homo, near Leiva, Department of Boyacá, and from what Hettner called the Guaduas formation. The material was collected by Dr. M. A. Rollot of Bogotá, and is of great importance in evaluating the age of the extensive coal-bearing series of rocks in Colombia.

Recently Dr. George Sheppard of the Anglo-Ecuadorian Oilfields Limited, sent me a collection of fossil fruits from the Ancon Point sandstone of Santa Elena Peninsula, Ecuador. Among these are several specimens, not very well preserved but probably representing *Anacardium peruvianum,* as Dr. Sheppard recognized. The exact locality is Ida Seca, Ancon.[4]



Figs. 1, 2.—*Anacardium kirni* Berry, n. sp., Eocene of Texas.

A second fossil species of *Anacardium* fruit was described in 1924[5] from the middle Eocene between Arroyo Mancamajor and Ovejas, Department of Bolivar, Colombia. This is a much larger and otherwise different form from *Anacardium peruvianum.*

The preceding fossil species, like all of the Recent species, are from the American Equatorial region. This summer I received from Mr. Albert J. Kirn a collection of leaves and fruits from the lower Eocene (Wilcox) near Lytle, Atascosa County, Texas. Among these is a seed of *Anacardium,* and this may be named for the collector, and partially described as follows:

Anacardium kirni Berry, n. sp.

Seed unsymmetrically reniform in side view (Fig. 1) somewhat compressed, broadly rounded distad, narrowed and pointed proximad, somewhat bean shaped, but less symmetrical than any legume known to me. Length, 17 mm.; maximum width, 12 mm.; maximum thickness, 9 mm., decreasing proximad (Fig. 2). Surface smooth. Sinus about 4 mm. above the base. No trace of the seed coat.

As this species is based upon a single specimen it cannot be properly described, nor can the possible limits of variation be determined. In the

[3] E. W. Berry. Amer. Journ. Sci. **8**: 124. *Figs. 1–8.* 1924.
[4] Geo. Sheppard. Pan-Amer. Geol. **49**: 271–274. 1928.
[5] E. W. Berry. *Idem.* **42**: 261. *Figs. 1, 2.* 1924.

abundant material of *Anacardium peruvianum* there is a very considerable amount of variation in both size and shape, and some variants are not appreciably different from the present Wilcox species. However, it is highly improbable that a single botanical species ranged from Texas to Peru, and from the lower Eocene to the Oligocene, which is the main reason for describing the Texas form as a new species. It adds a strictly tropical element to the very extensive flora that is now known from the Wilcox Eocene, and marks the earliest known occurrence of the genus *Anacardium.*

PALEOBOTANY.—*Seeds of a new species of Vitaceae from the Wilcox Eocene of Texas.*[1] EDWARD W. BERRY, Johns Hopkins University.

In my summary account of the lower Eocene Wilcox flora, which will be published by the U. S. Geological Survey as Professional Paper 156, there are enumerated 43 orders, 82 families, 179 genera, and between five and six hundred species. Two representatives of the family Vitaceae, based upon leaf impressions, have been described as new species of *Cissites*—a form genus proposed by Oswald Heer in 1866 for fossil leaves of Vitaceae of undeterminable generic affinity.

In a collection of Wilcox fruits and leaves received recently from Mr. Albert J. Kirn, and coming from a locality near Lytle, Atascosa County, Texas, there is a well preserved seed which appears to me to be related to both the tropical genus *Ampelocissus,* and to the temperate genus *Vitis*. This is of unusual interest in the questions which it suggests regarding the relationship of *Ampelocissus* and other existing tropical genera of the family to the essentially north temperate genus *Vitis,* as well as the possible northern or equatorial origin of the family, and especially of its most useful member, the grape.

The new species may be named for the locality, and described as follows:

Ampelocissites lytlensis Berry, n. gen. and sp.

Seed relatively small, ovate in profile, broadly rounded distad, bluntly and obliquely pointed proximad, with an inflated crustaceous coat. Somewhat flattened in the region of the furrows which result from the conduplicate habit of the embryo. There is a fairly sharp keel between these furrows, and the furrows themselves diverge somewhat distad and extend for slightly more than half of the length of the seed. On the opposite side from the furrows there is a well marked central elongated depression containing the hilum. This depression is continued upward to the apex as a shallow furrow,

[1] Received December 17, 1928.

and downward as a narrower raphe groove to the base at the chalazal pointed end. The surface of the seed is not evenly rounded but is thrown into irregular obliquely transverse ridges, as in *Ampelocissus* and *Tetrastigma*. Length, 4 millimeters; maximum width, 3.5 millimeters; maximum thickness, 1.75 millimeters.

This seed differs from those of *Vitis* in the shorter and less prominent raphe; in the less prominent furrows; and in the transverse ornamentation—hinted at in the southern ancestor of *Vitis rotundifolia* Michaux. The fossil lacks also the cordate apex and the stipitate base of *Vitis*. It resembles the seeds of *Ampelocissus* in all of these features, and I therefore propose the generic term *Ampelocissites* for its reception, and regard it as intermediate between *Ampelocissus* and *Vitis*.

The existing genus *Ampelocissus* of Planchon contains about 60 species of the tropics of both hemispheres. It is largely Old World (Asia and Africa), but is represented in the Antilles and Central

Fig. 1.—Dorsal, ventral, and side views of *Ampelocissites lytlensis* Berry, twice nat. size.

America, being largely replaced in the occidental tropics by numerous species of the prolific tropical genus *Cissus*. The fact that *Ampelocissus* occurs on three continents is in itself an indication of its antiquity, and a characteristic seed indistinguishable from those of the existing species has been described by the writer from the Eogene of northwestern Peru.

The genus *Vitis*, with about two score existing species, is confined to the northern hemisphere, although it thrives in cultivation in antipodean regions both within and outside the equatorial zone. The genus *Tetrastigma* contains about 40 existing species of tropical and sub-tropical Asia, and Malaysia eastward as far as New Guinea. A fossil species has been recorded from the upper Eocene of southern England, but no traces of the genus have ever been discovered in the western hemisphere.

The family Vitaceae makes its appearance in the geological record in the uppermost stage (Albian) of the Lower Cretaceous on both sides of the Atlantic (Maryland and Portugal), and is common throughout the Upper Cretaceous. These early forms are based upon foliar remains and are usually referred to *Cissites*. Fossil leaves that have

been referred to *Vitis*, sometimes upon evidence that is far from conclusive, are found from the base of the Eocene throughout the Tertiary, and seeds occur as early as the upper Eocene.[2]

PALEOBOTANY.—*The genus* Amygdalus *in North America*.[1] EDWARD W. BERRY, Johns Hopkins University.

The genus *Amygdalus*, with about five natural species confined to Asia in the existing flora, and innumerable cultivated varieties in all warm temperate countries, is usually considered by botanists as never having been a member of the North American flora, although some students believe that the genus *Emplectocladus* of Torrey, with four or five shrubby species in the western interior from California, Utah, and northwestern Nevada to Mexico, is closely related to *Amygdalus*.

Much has been written regarding the place of origin and the history of cultivation of the peach, nectarine, and almond; and the prevailing opinion appears to be that enunciated by DeCandolle in 1855 and again in 1895, that the peach was a native of China, and the almond of western Asia (Syria and Anatolia), although it is quite possible that the latter is endemic in other Mediterranean countries, e.g., Greece and Algeria.

In view of the many similarities between the flora of eastern Asia and North America, now a somewhat threadbare subject as regards existing plants, there is no *a priori* reason why *Amygdalus* should not be found fossil in North America; in fact, as long ago as 1883 Lesquereux described what he called *Amygdalus gracilis*[2] from the upper Miocene of Florissant, Colorado, and this was also reported from the middle Eocene of Wyoming, and later from the Eocene of British Columbia. The name *gracilis* has reference to the leaves on which the species was primarily based, but these are not distinguishable from those of *Prunus*, which are not at all rare in the North American Tertiary. The two supposed fruits (figs. 14, 15) which Lesquereux thought might be associated with the leaves are very unconvincing. They might be what he thought them to be and they might be various

[2] M. E. J. CHANDLER. Palaeont. Soc. 1923: 32. *tf. 14; pl. 5, f. 4.* 1925.

[1] Received December 17, 1928.

[2] L. LESQUEREUX. *The Cretaceous and Tertiary floras.* Rept. U. S. Geol. Surv. Terr. 8: 199. *pl. 40., f. 12–15; pl. 44, f. 6.* 1883.

other things—they are certainly too indefinite to prove the presence of *Amygdalus* in North America.

Some years ago I encountered rugosely pitted stones similar to those of a small peach in the lower Eocene (Wilcox) of Tennessee and Arkansas. These, like the several species of *Amygdalus* stones described from the Tertiary of Europe, which they greatly resemble, are smaller than those of the existing cultivated forms. The Wilcox stones greatly resemble those of *Amygdalus platycarpa* (Decaisne) of China. This Wilcox species will be fully described and figured in a volume devoted to the Wilcox flora now in press.

Recently I received from E. E. Alexander of Spokane, Washington, a nearly complete specimen and counterpart of what I regard as a stone of *Amygdalus*, which may be fittingly named for the collector, and described as:

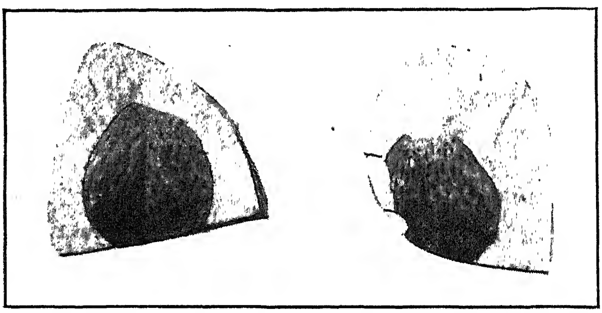


Fig. 1.—*Amygdalus alexanderi* Berry, n. sp., Miocene, Latah formation.

Amygdalus alexanderi Berry, n. sp.

Drupaceous stone, ligneous, ovate in outline, about 2 centimeters in length and 1.7 centimeters in maximum width as preserved in a crushed condition. The apparently rounded base is partly cut off by a joint in the clay matrix, and the apparently pointed apex is incomplete. The surface is strongly sculptured by a combination of relatively straight and sparingly branched ridges, less labyrinthine than in modern peach stones; and deep narrowly elliptical pits.

The stone was thoroughly rotten before it was finally covered by sediment, as is shown by the destruction of the original contour of the stone and by a slight overthrust from right to left seen down the middle of the face. The photograph of the counterpart shows a smooth marginal band in the upper left hand corner as though the specimen were a half of a stone and this were a part of the suture surface of the two halves. That the specimen does not represent a rugose capsule such, for example, as an unusually large *Fagus* capsule, which might be expected at this horizon, is clearly shown by the continuity of the surface in the above mentioned fold. Leaves which have

been referred to *Prunus* are not uncommon in the Latah flora, and it is possible that these leaves belonged to the same plant which bore these stones.

Although differing slightly from modern peach stones in the sub-parallel arrangement of the ridges and pits, I regard it as conclusive evidence of the presence of *Amygdalus* in the Miocene of western North America. The horizon is the Latah formation, and the exact locality is the Brickyard exposure in the city of Spokane.

If this and the Eocene species referred to are correctly determined, they mean that *Amygdalus* occurred in the western hemisphere quite as early as any that are known from the Old World, and that they were essentially southern or warm temperate in origin. It means further that peaches were probably an element in the North American flora from the Eocene throughout the greater part of the Tertiary, and that the late Miocene form of Washington was not an immigrant from Asia, but a survivor of the American stock in the far northwest, whose extinction during the climatic changes due to the elevation of the Coast ranges is easy to understand.

It is significant that a great many of the elements associated with *Amygdalus alexanderi* in the Latah flora survive to-day in only the Asiatic region (*Paliurus, Glyptostrobus,* etc.), or in the mesophytic region of southeastern North America (*Taxodium, Comptonia, Hydrangea,* etc.), or in both regions (*Hicoria, Liriodendron, Sassafras, Fagus, Ulmus, Castanea, Tilia, Magnolia, Liquidambar, Diospyros,* etc.), and only a few maintain a precarious existence in restricted relict environments in the west (*Juglans, Platanus, Aesculus,* etc.). All of the few examples mentioned have a long antecedent American history. *Amygdalus* thus parallels *Paliurus* and *Glyptostrobus*, with which it is associated both in the lower Eocene and Miocene.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE ENTOMOLOGICAL SOCIETY

400TH MEETING

The 400th regular meeting was held March 1, 1928, in Room 43 of the National Museum. The president, S. A. ROHWER, presided.

The president announced that he had recently appointed a committee on communications, consisting of Dr. T. E. SNYDER, Chairman, Drs. N. E. MCINDOO, and C. A. WEIGEL. The programs had previously been arranged by the Corresponding Secretary, with the assistance of other members.

Program: Dr. THOS. E. SNYDER: *A visit to Hawaii.* At the invitation of the Board of Commissioners of Agriculture and Forestry of Hawaii, the

speaker visited Honolulu to cooperate with territorial entomologists in attempts to control termites. The beauty of Honolulu, on the Island of Oahu, the hospitality of the inhabitants, and the fauna and flora were briefly discussed. The work of the Territorial and Federal entomologists, as well as those of the Sugar Planters Experiment Station and the Pineapple Growers Experiment Station, was outlined with particular reference to investigations of termites. Termites have been recorded from the Hawaiian Islands since 1883, but about fifteen years ago *Coptotermes formosanus* Schiraki was introduced from the Orient. This species is spreading rapidly and has become very destructive to the woodwork of buildings. The campaign being waged against this subterranean or ground-nesting termite and against the earlier introduced injurious dry-wood termite, *Cryptotermes piceatus* Snyder, is conducted along two lines: (1) Offensive warfare consisting of poisoning the termites in soil or wood by the use of carbon bisulphid gas and dry Paris green; and (2) Defensive warfare by proper methods of construction of buildings to prevent attack by termites. It is proposed to include in the building code provisions to prevent termite attack. In the office of the territorial entomologist is a large map on which the spread of the ground-nesting termite is plotted. This termite is the more injurious, since the dry-wood termite, though more widespread, does not so seriously weaken the woodwork of buildings. The recommended provisions will increase the initial cost of a building 2 per cent; more stringent recommendations, increasing the initial cost 10 per cent, are not considered advisable for a mandatory building code. The excellent educational work being done by Mr. Alexander Hume Ford, Director of the Mid-Pacific Science Institute, was also briefly described. (*Author's abstract*).

Discussed by BACK, ELY, GRAF, and MCINDOO.

E. R. SASSCER: *Some problems in the enforcement of foreign plant quarantines.* The speaker discussed problems in connection with the enforcement of foreign plant quarantines at maritime and Mexican border ports of entry.

Discussed by MCINDOO.

C. P. CLAUSEN spoke briefly on the life history and biology of some parasitic Hymenoptera.

C. T. GREENE, *Recording Secretary, pro tem.*

401ST MEETING

The 401st regular meeting was held April 5, 1928, in Room 43 of the National Museum. The president, S. A. ROHWER, presided.

OSCAR WHITAKER, of Halliburn, British Columbia, was elected to membership.

The Executive Committee recommended that the Society contribute $125.00 to the fund for the entertainment of foreign visitors to the Fourth International Entomological Congress to be held at Ithaca in August, 1928, this sum to be obtained by contributions from the local members of the Society.

Program: MAX KISLIUK, JR.: *Experiences in Argentina, Spain, and the Canary Islands in connection with fruit-fly surveys.* A general idea of the agricultural conditions, especially in regard to water, soil, elevation, and weather, in the fruit-growing zones in these countries was presented. In Argentina the speaker found *Anastrepha fraterculus* Wied on the wing, resting on fruit, and the larvae in various fruits in the Provinces of Tucuman and La Rioja. *Ceratitis capitata* Wied larvae were found in grapes in the Province of La Rioja. After finding *Ceratitis capitata* in nearly ripe Almeria grapes in Spain's two most important

grape-growing zones, Dalias and Berja, he proceeded to survey seven other Almeria grape sections, where he was told that for various reasons—freezing winter temperatures, high altitudes (up to 3,500 feet above sea level), lack of other fruit hosts, etc.—he would not find the grapes infested. He found these sections infested, however, and proved his findings to the satisfaction of the Spanish authorities. Although the Mediterranean fruit fly is more abundant on the Canary Islands than at any other section previously inspected, there was no infestation by this pest in tomatoes, here or in Spain. Among the many lantern slides shown was one picturing the vineyard where originated the infested grapes intercepted in New York in 1926, and where he now found the Mediterranean fruit fly. Slides showing various vineyard conditions, hauling, selecting, packing, and shipping were shown. Among these were some picturing growing conditions for tomatoes, bananas, onions, and the cactus for cochineal on the Islands.

F. C. BISHOPP: *Fighting insects on the great ranches of the Southwest.* Range conditions and practices employed in the Southwest, and the outstanding problems in which the entomologist is interested were outlined. The accomplishments of the Department in controlling some of the external parasites of live stock, such as the cattle-tick and the scab-mites of cattle and sheep, were described, and also the experimental work which the Bureau of Entomology is carrying on in Texas. The importance of developing effective control measures against goat lice, horse flies, and other insects affecting live stock, was discussed, and also the extensive range operations, particularly trapping, which are employed in combatting the screw worm. A number of lantern slides were shown.

Among the visitors present at the meeting were Dr. BERNARD TROUVELOT of Station Entomologique, Paris, France, and Dr. JEAN DUFRENOY, phytopathologist, also of Paris, France, who, on introduction by the President, greeted the assembled members.

402D MEETING

The 402nd regular meeting was held May 3, 1928, in Room 43 of the National Museum. The President, S. A. ROHWER, presided.

The Treasurer reported that 25 members had already contributed to the Society's donation to the local committee in charge of the Fourth International Entomological Congress and that contributions received to date total approximately $125, the amount asked for.

Program: DR. J. R. CHRISTIE: *Some aspects of the interrelationship of insects and nemas.* The rôle of insects as vectors or mechanical carriers of nemas was briefly discussed. The unique cyst-forming nema, *Rhabditis coarctata* and the insect-dispersed "red-ring" disease of the cocoanut palm caused by *Aphelenchus cocophilus* were among the examples noted of this type of relationship. Brief mention was made of the rôle of insects as secondary hosts of parasitic nemas belonging to the families Filariidae and Spiruridae. Principal emphasis was placed on the rôle of insects as primary hosts and the pathological conditions which result from this type of parasitism. In this connection comment was made on *Howardula benigna,* a nemic parasite of various species of *Diabrotica.* The economic importance of the Mermithidae was discussed, the discussion being based largely on the results of investigations by the speaker on *Mermis subnigrescens* and *Agamermis decaudata,* parasites of grasshoppers.

Discussed by HOWARD, MCINDOO, GRAF, ALDRICH, CAMPBELL, EWING, and HYSLOP.

Dr. G. F. White: *The disease problem in entomology.* Diseases of insects are an extremely important natural factor in the control of a number of injurious species, as is shown by the enormous mortality which is continually being observed among them. Insects being animals, their diseases might be expected to be, and indeed have been found to be, fundamentally similar to those affecting man and other animals. In a study of the insect diseases, therefore, the pathologist is confronted with problems similar to those encountered in the study of human and other animal diseases. The training necessary for the successful study of insect diseases is similar to that of the human and comparative pathologists. Fungus, bacterial, helminthic, protozoan, and filterable-virus diseases occur among insects. Each of these groups of diseases is fundamentally similar to a parasitism of insects where an insect is the parasite. In an effort at artificial control of an insect pest by means of its diseases, results of the same general character may be expected as are being obtained through insect parasitism. When the maximum number of environmental factors available is employed in control work, the fungi, the bacteria, the helminths, the protozoa, and the filterable viruses will be included. An enormous and extremely important field for research is the study of the transmission of the diseases of man, of other animals, and of plants, by insects. Entomologists have a further contact with disease problems in the injuries done directly by insects to man, other animals, and plants.

403d meeting

The 403d regular meeting was held June 7, 1928, in Room 43 of the National Museum. President S. A. Rohwer presided.

Mr. Rohwer stated that somewhat more than the amount pledged by the Society for the entertainment of foreign visitors in attendance at the 4th International Congress of Entomology held at Ithaca, had already been received. It was expected that the visitors would come to Washington, and that the Society would desire to provide some entertainment for them, and he recommended that the amount over and above the pledge be made available for any expenses connected with such entertainment. The tentative program included a visit to Plummers Island, and it had been suggested that a special meeting of the Society be called and an informal smoker also be arranged.

Program: R. A. Cushman: *The C. F. Baker Collection.* Mr. Cushman's talk, illustrated by lantern slides, was largely a description of the methods of packing the Baker Collection and its transportation from Los Banos, P. I., to Washington. He prefaced his remarks by a brief statement of the work and character of Professor Baker.

Discussed by Rohwer, who commented on the good condition in which the collection arrived at the Museum and on the general nature of its contents; by Aldrich, who spoke of his personal association with Prof. Baker years ago in the West, notably in Colorado; and by Graf, who gave some impressions of Prof. Baker while a student under him for 2 years.

Dr. McIndoo gave a brief review of some recent entomological literature.

Dr. Aldrich gave a brief review of the newly issued 185th fascicle of "*Genera Insectorum,*" this being a work on the Empididae by Dr. Melander, who has devoted a considerable portion of his time since 1900 to its preparation.

SPECIAL MEETING

Following the adjournment of the Fourth International Congress of Entomology at Ithaca, N. Y., August 18, many of the foreign delegates came directly or indirectly to Washington, where a special meeting of the Entomological Society of Washington was held in their honor. The meeting was held August 21, 1928, in the Assembly Hall of the Cosmos Club and was attended by about 200 persons.

President S. A. ROHWER made a brief address of welcome and introduced as chairman of the meeting Dr. C. L. MARLATT, Chief of the Bureau of Entomology and an ex-president of the Society. Dr. MARLATT welcomed the guests, and told briefly of the social side of the earlier meetings of the Society. He suggested that, this being a meeting of a local society and not connected with the Congress, probably no better plan could be adopted than to discuss the entomological societies of the world. As so many of these societies were represented at the meeting, such a discussion should prove illuminating. He called attention to the fact that the two oldest of the world's entomological societies were represented by Prof. E. L. Bouvier, Honorary President of the Société entomologique de France, and by Mr. J. E. Collin, President of the Entomological Society of London. Each of the following visitors spoke about the entomological society to which he belonged and which he had, officially or unofficially, represented at the International Congress: FRANZ HEIKERTINGER, Zool.-bot. Gesellsch., Vienna, Austria. ANTOINE BALL, Mus. Roy. Hist. Nat., Brussels, Belgium. KAI LUDVIG HENRIKSEN, Zool. Mus. Copenhagen, Denmark. JAMES E. COLLIN, Ent. Soc. London, England. HASSAN C. BEY EFFLATOUN, Plant Prot. Sect. Min. Agric., Cairo, Egypt. Dr. EDOARDO GRIDELLI, Mus. Civ. Stor. Nat., Genoa, Italy. Dr. ELISABETH SKWARRA, Univ. Königsberg, Königsberg, Germany. Dr. UNIO SAALAS, Univ. Helsinki, Helsingfors, Finland. Dr. CANDIDO BOLIVAR Y PIELTAIN, Mus. Nac. cienc. nat., Madrid, Spain. Dr. N. A. KEMNER, Ent. Føren., Stockholm, Sweden. Dr. ALFONS DAMPF, Mexico, D. F., Mexico. Dr. N. M. RIMSKY-KORSAKOV, Forst. Inst. Univ., Leningrad, Russia. Prof. RYSZARD BLEDOWSKI, Univ. of Warsaw, Warsaw, Poland. W. J. J. ROEPKE, Landbouwhoogeschool, Wageningen, Holland. Dr. E. L. BOUVIER, Mus. Hist. Nat., Paris, France. Dr. FRITZ STELLWAAG, Zool. Stat. Weinbauversuchsanst., Neudstadt, Germany. Dr. JAMES WATERSTON, British Museum, London, England. Prof. FILIPPO SILVESTRI, R. Ist. Sup. Agr., Portici, Italy. R. G. JEANNEL, Mus. Hist. Nat., Paris, France.

Dr. MARLATT, after Dr. BOLIVAR had spoken, called upon Dr. C. W. STILES, of the U. S. Public Health Service, and Dr. W. M. MANN, Director of the U. S. Zoological Park, to speak briefly, and after Dr. DAMPF of Mexico had spoken, he introduced Dr. ALEXANDER WETMORE, of the U. S. National Museum, who gave friendly greetings to the delegates. Prof. E. L. Bouvier, of Paris, announced that, on the authorization of his government, he and the French delegation had that day presented to Dr. L. O. HOWARD the cross of Officer of the Legion of Honor. Dr. MARLATT then called upon Dr. HOWARD to say a few words. A fine spirit of enthusiasm prevailed at the meeting. The older members of the Society remarked that it was probably the largest meeting of the Entomological Society of Washington that had been held in the course of its forty-four years of existence.

After adjournment a buffet supper was held in the lobby.

404TH MEETING

The 404th regular meeting was held October 4, 1928, in Room 43 of the National Museum. President ROHWER presided.

Dr. VASCO M. TANNER, Brigham Young University, Provo, Utah, was elected to membership.

Mr. ROHWER stated that in accordance with the plans made by the Society to contribute $125 to help defray the cost of entertainment of the foreign visitors at the Fourth International Congress of Entomologists held at Ithaca, the Treasurer had forwarded to the Chairman of the local committee the amount which the Society had promised. The Society had authorized entertainment for the foreign delegates who visited Washington after attending the International Congress, and now it was necessary for the Society to pay the expenses incurred by the executive committee for entertaining these visitors. An assessment of $2.00 had been levied upon local members, but this amount would not be adequate and it was hoped that the necessary balance of the $240 would be secured by special donations from the members. He urged that the local members give this matter early consideration, since the obligations had been incurred by individuals rather than in the name of the Society, and some of the bills had been paid by the men assuming the responsibility.

The Chair announced the death of Dr. Jean Brethes, one of the better known entomologists from South America, who had been particularly interested in the taxonomic phases of entomology and who had devoted considerable attention to the classification of Hymenoptera and Diptera. Dr. Brethes died at Buenos Aires, July 2.

Program: AUSTIN H. CLARK. *Butterflies of the District of Columbia.* There are 86 species of butterflies known from the District of Columbia. One species, *Catopsilia sennae,* which is not infrequent in late summer is represented here by males only. Two others, *Danaus menippe* and *Cynthia cardui,* usually common in the summer, do not survive the winter but the District is restocked each spring by individuals apparently coming from nearer the sea. The speaker called attention to the large dark short-winged form of *Junonia coena* which is confined to bogs and is very local, designating it as the "wet" form. He showed a comparable "wet" form of *Cynthia atalanta.* Neither of these "wet" forms survive the winter, spring individuals being of the usual "dry" form only. In the District *Cynthia cardui* is represented only by the "wet" form, excepting in early spring when occasional specimens of the small dull "dry" form may sometimes be seen near the river. Apparently these wander in nearly every year. The dark shortwinged summer individuals of *Polygonia interrogationis* and *P. comma* are simply "wet" forms of those species. (*Author's abstract.*)

Discussed by ROHWER, MCINDOO, HOWARD, ELY, and BRIDWELL.

H. S. BARBER: *Cave and other subterranean beetles.* Interest in subterranean beetles has been revived by the recent visits of certain European students, Drs. Jeannel, Bolivar, and Rambusek. That hardly twenty-five blind subterranean species are known from America in contrast with perhaps 500 from Europe may indicate either neglect on our part or a very interesting problem in zoogeography. It is hoped that greater interest in the investigation of this fauna may be developed in America. Most insects normally are sheltered in the ground for part of their lives and pressure of adverse surface environment, or peculiar fitness to life in the holes left in the subsoil by worms, decaying roots, rock crevices, or the burrows of large animals, may have

shortened their periods of surface activity until they no longer appeared above ground. Reduction of pigment, wings, eyes, etc., would naturally follow, accompanied by development of compensatory adaptations. *Anillus* was cited as an example of the minute, blind, wingless beetles probably inhabiting the soil throughout most of the United States, although recorded only from the Appalachians, Florida, Indiana, Texas, and California. It can be found under stones in early spring, but special methods of search can be developed for collecting it and those species which live similarly. *Rhadine* is an example of the local specialization from the ubiquitous, light-loving genus *Plantynus* to the eyeless and otherwise highly specialized cavernicole described as *Comstockia subterranea*, and the numerous species form a somewhat regular series grading from habitation under stones in loose rock-falls from cliffs, or in burrows of animals, to complete adaptation to life in great caverns. Our few species of the much discussed genus *Anophthalmus* are, according to Jeannel 1920 (Bull. Soc. Ent. France, 1920, p. 152), distinct genera from the cavernicolous species of Europe and are survivals of an old light-loving fauna which is now known as represented only by a species in Japan, and another in Northern Europe. As our species are known only from a relatively few caves east of the Mississippi and south of the margin of the Illinoian and Wisconsin glacial drift, and as multitudes of caves are known in other regions, numerous new species may be expected. The speakers' experience in seeing seven specimens in more than twenty visits to caves contrasts strongly with his capture of a hundred specimens in traps set in a few caves and twice examined. (*Author's abstract.*)

Discussed by MANN, McINDOO, HOWARD, BRIDWELL, and EWING.

Dr. FRANK E. BLAISDELL, SR., of San Francisco, Cal. expressed his pleasure at the opportunity of being with us, and gave some reminiscences of previous visits to the museums of Washington and other eastern cities. He also gave a brief review of some of his work on various genera of Tenebrionidae, notably *Eleodes* and *Blapstinus*, and mentioned the work of Colonel Casey on this family. He stressed the value of obtaining detailed data on life history and the desirability of having on file an extensive series of immature stages of the insects for study. At the suggestion of Dr. HOWARD, he was requested by the Society to convey our greetings as a Society to our colleagues on the Pacific Coast.

A. B. GAHAN read extracts from a letter recently received from Alan P. Dodd, Brisbane, Australia, discussing work of the Commonwealth Prickly Pear Board, and reporting that parasites are not making much headway in attacking the *Cactoblastis* now working in prickly pear. "There is every reason to believe that *Cactoblastis* will solve the prickly pear problem in a few years; its rate of increase in the field is enormous and the destructive results are quite extraordinary."

A. H. CLARK read a letter from Greenfield, Mass., to Mr. Thornton W. Burgess transmitting a number of insects which were determined by Mr. A. N. Caudell as the European house cricket (*Gryllis domestica*). They were said in the letter to be exceedingly numerous in the houses at Greenfield. This is the first record for Massachusetts.

J. C. BRIDWELL reported recent collection near Barcroft, Virginia, of the imported willow-leaf beetle, *Plagiodera versicolora* Laith. Discussed by ROHWER.

J. S. WADE, *Recording Secretary.*

THE GEOLOGICAL SOCIETY

443D MEETING

The 443d meeting was held at the Cosmos Club November 14, 1928, President Hewett presiding.

Informal communications: N. H. DARTON exhibited a new geologic map of New Mexico and a photograph of an unpublished relief map of New Mexico by Mr. Renshaw. Discussed by Messrs. STOSE and CAMPBELL.

W. C. ALDEN showed views of a part of Glacier National Park that has recently been made accessible.

Program: C. P. ROSS: *Early Pleistocene glaciation in Idaho.* On and near Railroad Ridge, Custer County, Idaho, there are deposits of unconsolidated detritus, believed to be of glacial origin, which are out of harmony with the present topography. The evidence points to the detritus being the product of glaciation in early Pleistocene, possibly Nebraskan, time, and indicates that at that time the country was far less rugged than at present. Valley cutting of the order of 1,400 feet took place in the interval between this early glaciation and Wisconsin time, when the cirques and U-shaped valleys which are prominent features of the present topography were formed. This is in marked contrast to the erosion of 100 feet and less which has occurred in Recent time.

Similar, though less complete, evidence of ancient glaciation followed by deep erosion is known on Loon Creek farther north, and on Little Wood River farther south. All three localities are close to the highest peaks in Idaho. Evidence of similar conditions in the Pleistocene has been found by other investigators in Montana, Wyoming, and perhaps Washington. While two widely separated periods of glaciation are known in northern Idaho, neither appears to be as old as that here described.

Discussed by Messrs. CAMPBELL, MENDENHALL, CAPPS, FERGUSON, ALDEN.

M. R. CAMPBELL: *Value of river gravels in the study of deformation.* Discussed by Mr. STOSE.

E. O. ULRICH: *Paleogeographic data developed in the study of lower Paleozoic stratigraphy in Oklahoma.* Discussed by Mr. BASSLER.

444TH MEETING

The 444th meeting was held at the Cosmos Club November 28, 1928, President Hewett presiding.

The Secretary announced the deaths of J. S. DILLER and T. C. CHAMBERLIN.

Program: LÉON W. COLLET, Professor of Geology, University of Geneva, Switzerland, and Harvard University: *Origin of the lakes of the Swiss Alps.*

Discussed by Messrs. STOSE and MENDENHALL.

445TH MEETING

The 445th meeting was held at the Cosmos Club December 12, 1928, President Hewett presiding. Vice-President G. R. Mansfield took the chair during the presentation of the address of the retiring President.

Presidential address: A review of European metal production.

36TH ANNUAL MEETING

The 36 annual meeting was held at the Cosmos Club after the adjournment of the 445th regular meeting, President Hewett presiding.

The annual report of the Secretaries was read. The Treasurer presented his annual report showing an excess of assets over liabilities of $1142.56 on December 12, 1928. The auditing committee reported that the books of the Treasurer were correct.

The results of balloting for officers for the ensuing year were as follows: *President:* S. R. CAPPS; *Vice-Presidents:* G. R. MANSFIELD, O. E. MEINZER; *Treasurer:* H. G. FERGUSON; *Secretaries:* A. A. BAKER, JAMES GILLULY; *Members-at-large of the Council:* N. L. BOWEN, H. D. MISER, H. N. SHORT, W. D. COLLINS, J. B. MERTIE, JR.; *Nominee as Vice-President of Washington Academy of Sciences representing the Geological Society:* D. F. HEWETT.

W. W. RUBEY, A. A. BAKER, *Secretaries.*

SCIENTIFIC NOTES AND NEWS

A. A. STOYANOFF, Professor of Paleontology at the University of Arizona spent several days during the first week of January at the National Museum comparing fossils from the early Paleozoic of Arizona with material in the Museum's collections.

Professor and Mrs. CARROL LANE FENTON recently visited the National Museum to study collections of Devonian brachiopods from Iowa in connection with their work on the development of these forms.

Dr. CHARLES RYNYKER, paleontologist with the Gypsy Oil Company at Tulsa, Oklahoma, visited the National Museum to examine microfossils.

Obituary

Sebastian Jacob Mauchly, a member of the Academy and a former editor of this Journal, died December 24, 1928, at his home in Chevy Chase, Maryland, after a long illness. Dr. Mauchly was born in 1878 at Swanton, Ohio, studied at Ohio State University and University of Chicago, and as Hanna research fellow received the degree of doctor of philosophy from the University of Cincinnati in 1913. As physicist with the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, he specialized in terrestrial electricity and as chief of the Section of Terrestrial Electricity of the Department was responsible for the development and improvement of many instruments for observing the electric elements at field and observatory stations. He made numerous valuable contributions to this branch of science and was first to call attention to the apparent universal twenty-four hour term in the diurnal variation of the Earth's electric field. This fundamental result was deduced by him largely from his discussions of the work at sea by the Carnegie and he later corroborated this conclusion by extensive investigations of results at land stations over the entire globe.

Erich P. Becher, Ordinarius Professor of Philosophy at the University of Munich and a member of the Academy, died recently at the age of 46. Professor Becher was in charge of the Psychological Institute of the University and was known for his work in natural philosophy, psychology, and ethics.

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GEOLOGY.—*Middle Devonian pelecypods of Wisconsin and their bearing on correlation.*[1] ERWIN R. POHL, Vanderbilt University. (Communicated by R. S. BASSLER.)

INTRODUCTION

It has been the pleasure and privilege of the writer for the past three years to engage in a coöperative effort, under the auspices of the United States National Museum and the Milwaukee Public Museum, to understand more fully the fauna of the Wisconsin Devonian formations and the relationship of these formations to those of other areas. A small, roughly semicircular patch in south-eastern Wisconsin preserves Middle Devonian rocks and a lone outlier near the Keweenaw on Lake Superior, Limestone Mountain, has yielded fossils of Helderbergian type. The latter are few, however, and their isolated presence in the north can shed no direct light on the connections of the Middle Devonian beds. The only significant fact to be learned from them is that of marine deposition on the flanks of the old Laurentian positive area.

The discovery of Middle Devonian types of fossils long ago established in a general sense the age of the Milwaukee and Ozaukee County deposits, but the literature shows a progressive tendency on the part of paleontologists to recognize the impropriety of unreserved identifications of the Milwaukee species with those described from New York, Ohio, Michigan, and Iowa. This tendency has brought into question the hypothetical narrow strait assumed to occupy in Mid-Devonian time a position within the present boundaries of Wisconsin and Michigan and to allow either complete or limited communication

[1] Received January 3, 1929. Read before the Paleontological Society, December 27, 1928.

between enormous contemporaneous eastern and western arms of the sea. It has recently been shown that the formations to the west in Iowa, to whose described forms many Wisconsin species were compared, belong not to the Middle but to the Upper Devonian—a fact in itself sufficient to put to rest the assumption of contemporaneity of the New York, Wisconsin, and Iowa species. Finally, from evidence afforded by a close study of the pelecypod fauna of the Milwaukee beds comes the conviction that there has been no commingling of faunas or species from the east and west.

As early as 1882 Whitfield, in describing several new species from the Milwaukee formation, pointed to differences in many others. In 1899 Teller and Monroe, amateur collectors but nevertheless close students, recognized enough difference in many fossils to compare them with nearly related described forms rather than to identify them unreservedly. H. F. Cleland described 35 new and well founded species and pointed to striking dissimilarities from described forms in as many more species although allowing them to remain within the scope of those forms. John M. Clarke, than whom in the past generation none had better knowledge of the New York Devonian, in personal correspondence with Cleland frequently placed his sanction on an identification of a Wisconsin species with one from New York only with the reservation that a question mark be annexed. The Echinodermata, as studied by Weller, Springer, and Cleland, show the distinction particularly well, for they belong almost without exception to completely differentiated and easily distinguished new types. The pelecypod association is unique, not a single instance having been found of unquestionable identification with forms elsewhere described.

Wisconsin Devonian Pelecypods

The Devonian section of eastern Wisconsin comprises three phases, separated from each other at present primarily on the evidence of the contained faunas rather than upon stratigraphy. Table 1 gives complete lists of the various pelecypod associations, and it need be remarked here only that specific distinctions are sharp between the lamellibranchs of the three formations.

In the Ozaukee and Thiensville beds (manuscript names used by G. O. Raasch for the lowermost phase of the Wisconsin Devonian), the preservation of the pelecypods is inadequate for more than generic comparison. The genera, among them *Conocardium*, *Schizodus*, *Janeia*, *Sphenotus*, *Leiopteria* and *Leptodesma*, are well-advanced

Devonian types and it is a little surprising to discover them at the base of the Devonian column in Wisconsin. The association would suggest a derivation similar to that of part of the lower Cedar Valley of Iowa.

The Lake Church formation (manuscript name of G. O. Raasch), the stratigraphic position of which is still in question, has yielded a small, but unique assemblage of fossil pelecypods. The derivation of the materials and of the fauna is not known. It is difficult to believe that an association of species so remarkably differentiated should have developed indigenously in as short a time and under as normal a condition as is indicated by the less than 20 feet of pure, dolomitic limestone to which, so far as known, they are confined. The presence of generic types known to have a northern origin such as *Ilionia*, *Conocardium* (*altum* and *brevialatum* groups), *Paracyclas* ("*elliptica*" group), *Schizodus* (*appressus* group), and *Lophonychia*, leads to the supposition of north-eastern if not Arctic connections for this fauna.

The Milwaukee formation contains a very abundant pelecypod fauna—43 species in 19 genera. The relationships of this fauna are with the North-Atlantic Hamilton fauna, whose typical development is in eastern New York (Table 2).

Middle Devonian of the Central Basin

Throughout extended stratigraphic work in the Middle Devonian of the Central Basin an understanding of the interrelations of the formations and their contained faunas has been the chief objective. The predominantly Hamilton aspect of the Milwaukee fauna has already been noted, and in searching for the path of its incursion we are immediately struck by its faunal isolation. In the remarkably complete development of Erian deposits in the adjacent south and east we look in vain for faunal connections. The contemporary invasions into the states on the south—Missouri, Illinois, Kentucky, Indiana, and southern Ohio—brought in generic types known to have a southern derivation and totally unlike the Milwaukee forms.

Of other comparable sections we have only the profusely fossiliferous Michigan series. It is natural to look toward these nearest Middle Devonian deposits for illumination, but here a hitherto entirely unsuspected problem arises. Only the salient features of the Michigan section and the exact stratigraphic position it holds will be noted here, for the detailed sections and evidence for the assignments made are the subjects of present studies by the author. The Silica shale of northwest-

TABLE 1.—STRATIGRAPHIC DISTRIBUTION OF SPECIES

A. MILWAUKEE FORMATION

	Zones. A.	Zones. B.	Zones. C.
Grammysia ulrichi Pohl	....	×	....
G. marginata Pohl	....	×	....
G. regularis Pohl	....	×	....
Cimitaria obtusiloba (Cleland)	....	×	....
Edmondia fragilis Cleland	....	×	....
Nucula triangula Pohl	....	×	....
Nuculites laphami Cleland	....	....	×
Palaeoneilo milwaukeensis (Cleland)	....	....	×
P. sp. cf. *constricta* (Conrad)	....	×	....
P. pulchella Pohl	....	?	×
P. devexa Pohl	....	×	....
P. corrugata Pohl	?	×	....
P. corrugata angulata Pohl	×	....	....
P. persinuata Pohl	....	....	×
P. dentata Pohl	....	....	×
Nuculana gibbosa Pohl	....	....	×
Megambonia wisconsinensis Cleland	×	....	....
Leiopteria acutilaris Pohl	....	....	×
Actinopteria rhombolineare Pohl	....	....	×
A. pauciradiata Pohl	×	....	....
A. singularis Pohl	....	....	×
A. sp.	....	×	....
Mytilarca cingulosa Pohl	....	×	....
M. dentata Pohl	....	×	....
Plethomytilus suberectus Pohl	....	×	....
Lophonychia cultellata Pohl	....	×	....
Conocardium ornatum Cleland	....	....	×
Aviculopecten bassleri Pohl	....	....	×
A. hystriculus Pohl	....	....	×
A. duplicostatus Pohl	×	....	....
A. sp.	....	....	×
Vertumnia telleri Cleland	....	×	....
V. simplex Pohl	....	....	×
V. barretti Pohl	....	....	×
V. intercalaris Pohl	....	....	×
V. edwardsi Pohl	....	....	×
V. raaschi Pohl	....	×	....
Schizodus dubius Pohl	....	×	....
Modiomorpha saccula Pohl	....	×	....
M. elongata (Cleland)	....	×	....
M. pediformis Pohl	....	×	....
M. obliqua Cleland	×	....	....
M. mytiloides milwaukeensis Pohl	....	×	....
M. schucherti Cleland	....	×	....
Paracyclas paradoxica Pohl	....	....	×
P. sp.	....	×	×

B. Lake Church Formation

?*Pterinea paucicostata* Cleland
Actinopteria convexa Pohl
Lophonychia trigonale (Cleland)
Conocardium truncatum Pohl
C. auritum Pohl
C. intersculptum Pohl
Schizodus acutangulus Pohl
Paracyclas obesa-umbonata Pohl
P. elliptica milwaukeensis Pohl (?)
Ilionia tenuistriata (Cleland)

C. Ozaukee and Thiensville Beds

Conocardium sp.
Schizodus sp.
Janeia cf. *vetusta* Meek
Sphenotus cf. *contractus* (Hall)
S. sp.
Leiopteria sp.
Leptodesma sp.

TABLE 2.—Taxonomic Affiliation of the Pelecypods of the Milwaukee Formation

Wisconsin	New York (Lower Hamilton)
Grammysia ulrichi Pohl	*G. nodocostata* Hall
G. marginata Pohl	*G. nodocostata* Hall
G. regularis Pohl	*G. arcuata* (Conrad) *G. subarcuata* Hall
Cimitaria obtusiloba (Cleland)	*C. recurva* (Conrad) *C. corrugata* (Conrad)
Palaeoneilo sp. cf. *constricta* (Conrad)	*P. constricta* (Conrad)
P. dentata Pohl	*P. constricta* (Conrad)
P. corrugata Pohl	*P. emarginata* (Conrad)
P. corrugata angulata Pohl	*P. emarginata* (Conrad)
P. pulchella Pohl	*P. fecunda* Hall
P. devexa Pohl	*P. maxima* (Conrad)
Nuculana gibbosa Pohl	*N. rostellata* (Conrad)
Megambonia wisconsinensis (Cleland)	*M. cardiiformis* Hall
Leiopteria acutilaris Pohl	*L. conradi* Hall
Plethomytilus suberectus Pohl	*P. oviformis* (Conrad)
Conocardium ornatum Cleland	*C. cuneus* (Conrad)
Actinopteria rhombolinearis Pohl	*A. boydi* (Conrad) *A. quadrula* (Conrad)
Vertumnia barretti Pohl	*V. reversa* Hall
V. simplex Pohl	*V. avis* Hall
Modiomorpha saccula Pohl	*M. concentrica* (Conrad)
M. elongata (Cleland)	*M. concentrica* (Conrad)
M. pediformis Pohl	*M. mytiloides* Hall
M. mytiloides milwaukeensis Pohl	*M. mytiloides* Hall

ern Ohio is nothing more than the exact equivalent of the Bell shale at the base of the Michigan Traverse. At Silica the Bell shale rests disconformably on the Columbus limestone (of true Onondaga affinities). Thus the lower boundary of the Traverse is definitely established. Three oscillatory phases of the Traverse are developed on the two sides of the state, in the northern part of the southern peninsula, to a maximum thickness exceeding 500 feet. The Thunder Bay phase, or uppermost division in eastern Michigan, carries a peculiar and profuse assemblage of species which are also to be found in the lowest exposed beds across Lake Huron in Ontario. The top of the beds in Ontario, the so-called Olentangy shale, is separated by overlap from the succeeding "Widder beds," which in turn are directly correlatable with the middle of the Hamilton section at East Bethany, in central New York. Upper and lower limits are thus clearly defined for the Michigan Traverse, no part of which is correlatable with the true Hamilton of eastern New York. The Marcellus deposits may be in part a time-equivalent of the Traverse, but stratigraphic evidence indicates a minimum of 500 feet of interruped limestone deposition in the east-central Basin between the Onondaga and the Hamilton. In view of the stratigraphic position occupied by the Traverse, despite the fact that it also is of northern invasion, it is not unexpected that we find no relation of faunas nearer than generic similarity between the Milwaukee and the Michigan beds.

The upper Devonian age of the Iowa formations has already been noted, and by the process of elimination we are left with only inferential faunal and stratigraphic evidence of the derivation of the Wisconsin Devonian.

CONCLUSION

The northern complexion of the Milwaukee fauna, the complete lack of stratigraphic equivalents in surrounding regions, the isolation of the area, the singularity of specific types, and their close although easily distinguishable relation to the north-Atlantic Hamilton, has thus far been summarily reviewed. Alternative paths of seaway encroachment now suggest themselves. Considering the possibility of approach by way of the South Laurentian-St. Lawrence trough, no indications of ingress by that route are afforded. Contrarily, the possibility is denied by the present absence of Devonian beds and the resulting necessity for complete removal of all Devonian beds from this area subsequent to deposition. Thus we arrive at the assumption

that the invasion encroached from the north by means of connection with James Bay around the north of the Laurentian positive area.

The unique assemblage in the limited area in eastern Wisconsin can not be considered an indigenous fauna because of its close connection with that confined to the Hamilton (Skaneateles) of eastern New York. The specific distinction is rather to be explained on the basis of non-contemporaneity, since both faunas were derived from the same mother oceanic association. Absence of several types or the presence of new ones in either of the areas is incidental and due to the changing character of the associations in the permanent basins and the ecologically varying conditions in the two regions. Stratigraphic and faunal inferences necessitate an extremely late Erian time equivalency for the Milwaukee formation, and it is probable that all of the Devonian in the eastern part of Wisconsin is later in deposition than any portion of the typical Hamilton.

PALEONTOLOGY.—*The status of the classification of the trilobites.*[1] E. O. Ulrich, U. S. Geological Survey.

The classification of the trilobites in both modern and older textbooks suggests that they fall as readily into line as though made to order. The genera and families seem sharply defined, and the descriptions seldom indicate any doubt regarding the soundness of the arrangement. However, the critical student who seeks to prove the indicated relationships for himself soon notes discrepancies and incongruities that grow and multiply till his confidence is weakened and finally almost destroyed. Such at least has been my experience during the twenty years or so that I have devoted mainly to the study of one after another of the genera and families of trilobites. The results of these studies, usually at variance with the views of the authorities, are only now being completed to the point where I might consider myself warranted in publishing them. But they were extensively employed and have always been available as paleontological criteria in the stratigraphic investigations that primarily occasioned the study of the fossils.

Prevailing conceptions regarding the systematic relations of the Ordovician and older trilobites are too largely based on overworked theories, weakly grounded deductions, and pure assumptions employed indiscriminately as though they were established facts and immutable

[1] Received January 3, 1929. Published by permission of the Director of the U. S. Geological Survey.

laws. In other words, quoting from a recent reviewer,[2] "The determination of the significance of structural conditions is based less on what may be or has been observed than on biologic theories." Though fully convinced that most of our theories of evolution are essentially true and properly applicable in certain cases, it yet seems to me they have been so burdened by unreserved and too often quite unwarranted applications that the confidence really due them has been seriously impaired. No laws of evolution have yet been discovered which, in the present state of knowledge, may be applied without reservation and severe limitation. Usually the actual genetic relations of extinct organisms, on the one hand, and the general trend of their evolutional modification, on the other, are only very obscurely indicated in the tangled and interwoven skein of life-processes that nature has preserved in accessible fossiliferous rocks. And so the paleontologist must do his part in working out the by no means simple methods through which the present stages in the ever changing expression of life history were achieved.

A moment's thought suffices to convince the worker that the available fossil remains are but occasional small bits of ramifying threads whose distal ends can only rarely be ascertained and whose proximal ends or roots are most difficult to recognize in the maze of heredity. Characters that are generally developed in the early stages of a particular line and subsequently lost, may be temporarily revived and without apparent warning in almost any of its later stages or off-shoots. In other cases the general trend of the evolution of certain parts is suddenly reversed. Such apparent anomalies not only result in mistaken conclusions regarding the age of the fossils, but they also inject unwelcome doubt as to the verity of previously fixed conceptions which seemed to work satisfactorily enough so long as the field of work was limited and disturbing factors were few enough to be neglected. Fossils were loosely identified, and the idea of local variations of species covered a multitude of stratigraphic sins. Now, however, since other ideas have crept into stratigraphy and our field of investigations has been extended to Paleozoic basins wholly unknown or barely touched before, the disturbing factors have become so numerous that they can no longer be ignored.

One of the striking collateral results of this expansion is the fact that more new things are in hand and awaiting publication than at any

[2] RUDOLF RICHTER. Reviews in Neues Jahrb. Min. Geol. Pal., Jahrg. 1922, Bd. 2, Heft 3, 1923.

preceding time since we began to study fossils. But it should not be supposed that all or even most of these additions come from the recently discovered basins. On the contrary, by far the greater number have resulted from the more intensive and more securely founded restudy of fossil faunas and old collections that had been reported on long ago. As the sequence and field relations of geological formations became better understood, and the fact of frequent and varying oscillation of continental seas was established, the need of more intensive study of their fossil contents and the closer discrimination of species and varieties that would or might be of exact value in recognizing and correlating the particular stratigraphic horizons in which they occur became correspondingly pressing. The biological by-product of these more detailed studies is a steadily accumulating mass of data that bears directly on evolution in general and the genetic relations of fossil species and genera in particular. All of the various theories of evolution that still have adherents among zoölogists can find support in this mass of evidence. A master mind is needed to weave the scattered threads into a comprehensive scheme of organic evolution.

However, when it comes to the genetic relations of fossil species and genera the problems can be successfully attacked only by the specialists in stratigraphic paleontology. They have the required detailed knowledge of the concerned organic remains, and they alone have the exceedingly important stratigraphic information that enables them to check their knowledge of the things themselves with the chronologic aspects of each case. The latter factors, particularly as they concern the stratigraphic and paleogeographic ranges of the several specific and generic types, I deem absolutely essential before final conclusions are warranted.

Four conditions are mainly responsible for the many present doubts regarding the genetic and systematic relations of trilobites and other fossil organisms; and all arise from ignorance of the facts in the several cases.

First, and this applies especially to the trilobites, we know too little of the complete animal and can not entirely overcome the resulting doubt as to the original association of the dismembered parts that we bring together in describing our species and genera. Such features as the number and character of the thoracic segements, the free cheeks, eyes, doublure, epistoma, hypostoma, legs and other features of the ventral side, all of which are important factors in our inquiry, often remain entirely unknown.

Second, the available links in the lines of descent usually are too far apart.

Third, we often forget entirely or at least do not give adequate consideration to the fact that the geological record is far from complete, and thus we fail to appreciate the greatness of the break between certain systems. The effect of this lack of appreciation is particularly great in estimating the probable and possible changes that occurred during the exceedingly long time that separates the close of the Upper Cambrian and the beginning of the Ordovician, as these periods are now restricted and defined. An idea of its length is gained when we consider that two great systems of deposits, each fully equal in duration and possibly organic modification to either the Silurian or the Devonian system, are being slowly worked out and faunally characterized. Only a few years ago we knew practically nothing of the intervening Ozarkian and Canadian periods. And even now we are only beginning to realize what and how much happened during their terms in the way of modifying—in almost haphazard fashion—the ever-changing stream of life.

Fourth, since it has been established that the fossil marine faunas of deposits in continental basins invaded the latter, when occasion offered, from one or another of the oceanic realms in which their respective and characteristically different biota lived and accomplished the specific and generic changes observed in comparing the fossil faunas now accessible, the need of determining the originating source of the fossil remains has become no less essential in systematic investigations than in the age correlation of the beds containing them. Obviously, these determinations involve exceedingly complicated problems whose solution requires abundant and good material and much time. Progress is slow and usually not fast enough to keep abreast of new acquisitions.

To these four deterring conditions I might add another. This is the difficulty of correcting previous faulty or definitely erroneous determinations and plausible suggestions that have now become ingrained in the fabric of our text-books and literature in general. Most of these erroneous conceptions are occasioned by the usually laudable but incautiously exercised desire of zoölogists to bring into orderly arrangement the chaotic mass of inadequately studied fragmentary material on which, if we are to make any progress at all, we are obliged to found our descriptions of species and genera. In fact, though referring especially to the trilobites, we know so little about the subject in

general and about the genetic relations of the generic groups in particular that all preceding and any present effort to classify them into families and groups of higher rank can be nothing better than a provisonal arrangement. The paramount need of the present is to work out the facts.

PALEONTOLOGY.—Trachelocrinus, *a new genus of Upper Cambrian crinoids*.[1] E. O. ULRICH, U. S. Geological Survey.

Cambrian crinoids at all well preserved are extremely rare and desirable. They are particularly needed in these days when prevailing classifications are in course of modification along lines in which the genesis of the animals is being given greater consideration than heretofore.

The specimen that is the subject of this communication was collected by Dr. C. E. Resser and Mr. Robert Bassler from the upper part of the Gallatin limestone just above Hayden Falls, Republic Creek, a mile south of Cooke City, Montana. The particular bed in which the specimen was found is correlated with the "crinoid zone" of the Franconia formation in the upper Mississippi Valley where it lies between the top of the Ironton sandstone member and, as in the Montana section of the Gallatin, just under the widely distributed *Eoorthis* zone.

Though an unquestionable crinoid, it is exceedingly difficult to find a satisfactory resting place for this unique Cambrian fossil in any of the several classifications now in common use. It can hardly be referred to the Eocrinoidea: the stem is too well developed and the arms have a type of branching or pinnulation and a plate-covered ambulacral furrow, neither of which conditions is known to occur in that subclass. This crinoid is definitely of a higher order. Probably Jaekel's subclass Cladocrinoidea includes its nearest relatives, and it may be viewed as an early stage in the evolution of those crinoids. But none of the numerous cladocrinoid genera and families adopted or instituted by Jaekel can justly include our new crinoid. It must stand for the present as the type of both a new genus and a new family which we may provisionally place in the Order Dicyclica. This opinion is expressed despite the fact that considerable resemblance, at least in general aspect and structure, is notable on comparison with a large but as yet unpublished group of cystids that we have found in the Chazyan rocks of east Tennessee.

[1] Received January 3, 1929. Published by permission of the Director of the U. S. Geological Survey.

The arms are five in number, long and moderately stout, the brachioles arranged in a double series, each somewhat longer than wide, the fourth and eighth, and then each succeeding third or fourth on the left side of the arm, bearing a short biserial armlet approximately half as wide as the main arm. In the two arms that exhibit their bases the first brachial on the right side gives off a short armlet like those on

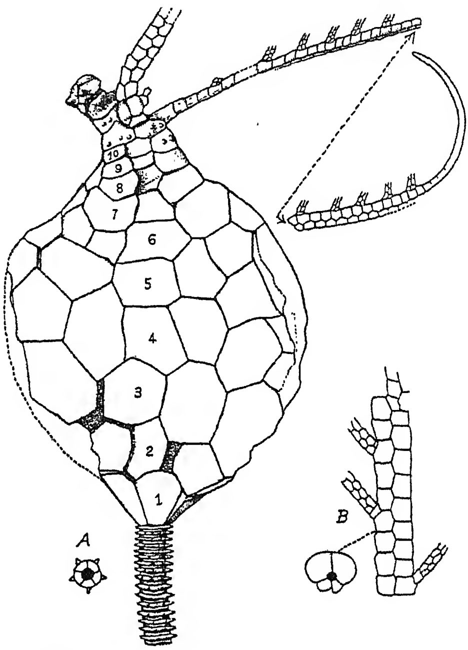

Figure 1.—Outline drawing, × 1.7, of the left side of the nearly entire but crushed specimen upon which the new genus and species *Trachelocrinus resseri* are based. The outline of the calyx, as it lies on the bedding plane of the slab of shaly limestone, is approximately normal, but the form and arrangement of the plates, the ranges of which are numbered 1 to 10 in the figure, was more or less disturbed under the weight of the sediments that reduced the opposite dimensions of the bottle-shaped calyx to less than one-fourth of its original diameter. Accordingly, most of the plates in the middle part of the drawing were originally wider. A, cross-section of column. B, lower part of arm showing its biserial character, the single pinnule or armlet on the right side, two of the armlets that occur on each succeeding third or rarely fourth brachiole of the left side, and a cross-section of the arm.

the left side of the arm. The ambulacral furrow on both the main arm and its short branches is narrow and covered with two alternating and relatively thick series of plates.

The column, of which about 2 inches is preserved, is round and in the proximal inch consists of alternating very thin and thicker 5-partite columnals, the sutures between them minutely crenulated on the surface. Each of the larger set carries, presumably, 5 spines.

The lumen is cylindrical and, excluding the outer spines, takes up about half of the diameter of the column. In the distal third of the

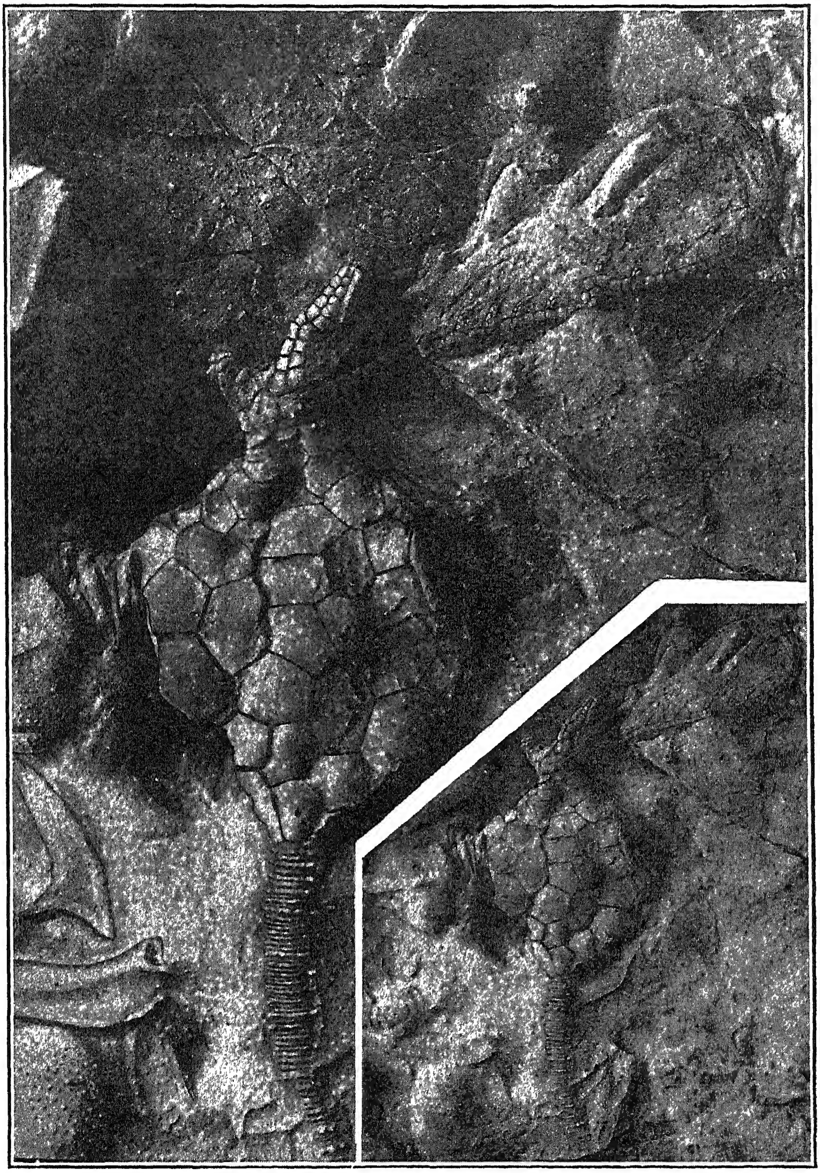

Figure 2.—*Trachelocrinus resseri* Ulrich, n. gen. and sp., nat. size and × 2

2 inches of column preserved the two sets of columnals are nearly equal in thickness.

Trachelocrinus resseri Ulrich, n. gen. and sp.

An apparently normally long-stemmed pentamerid crinoid, with subovate, urn or bottle-shaped body contracted above to form a relatively narrow neck-like support for the long arms. Neck trilobed in cross-section. Calyx, with numerous plates, arranged in irregularly alternating transverse ranges, most of those in the middle ranges hexagonal, the basal range five in number and pentagonal; the second, six and mainly hexagonal; the third, fourth, and fifth ranges more or less irregularly hexagonal and varying in number from nine to eleven; the sixth range heptagonal and probably nine in number; the seventh range—making base of neck—small, ten in number, five of them pentagonal, five smaller and quadrangular; the eighth, ninth and tenth ranges also ten each, small, much wider than high, and arranged in longitudinal series with the plates of the seventh and sixth ranges; the tenth range only five in number, as low as those under them but twice as wide and with the sutures between them falling over the middle of each second plate of the preceding four ranges. Finally, the arms are set directly over the sutures of the terminal neck range.

The excess in number above five and the irregularities in shape of plates in the third, fourth, and fifth ranges, which span the most inflated part of the calyx, is due to the intercalation of similar plates that in such more normally plated crinoids as the Cladocrinoidea would be called interradials. Indeed, the right half of the side exposed in the specimen suggests a larger "interradial" area that would correspond to the anal interradius. That this suggested orientation may well be correct is further indicated by the fact that whereas four of the arm bases are close to each other the fifth, which should be the anterior, lies farther from its neighbors and directly opposite the supposed anal interradius.

Basals five, high, pentagonal; above them six alternating ranges of plates, all but those of the last two ranges somewhat irregularly hexagonal. In the sixth range, beginning with the basals, the plates are heptagonal, the middle of the upper edge of each being truncated to support one of the series of small quadrangular plates which separate the sides of the larger pentagonal plates that make up the greater part of the seventh range. So far as can be seen, each of the ten plates of the seventh range is succeeded by a series of three short plates (at least twice as wide as long). These are succeeded by the final range which consists apparently of but five plates that carry nodes and are not longer but wider than the preceding ten-plate ranges. Finally the biserial arms rest on the sutures of the five-plate range.

ARCHAEOLOGY.—*On the recent finding of another flint arrow-head in the Pleistocene deposit at Frederick, Oklahoma.*[1] CHARLES N. GOULD, Director, Oklahoma Geological Survey. (Communicated by O. P. Hay.)

The Frederick gravel bed in which, during the past two years, a number of bones of prehistoric animals and several human artifacts have been found, is located on a ridge a mile north of the town of Frederick, county seat of Tillman County, southwestern Oklahoma.

[1] Received January 3, 1929.

The greater part of the surface of Tillman County consists of red clays and shales of Permian age. These shales have been eroded and dissected by streams flowing south, but, in general, the relief of the plains will not exceed 50 to 75 feet. The ridge upon which the gravel bed is located stands 80 to 100 feet above the surrounding plain, averages a half mile wide, and extends north of Frederick a distance of eight to ten miles, where it merges with the level uplands.

The gravel bed which caps this ridge is composed of typical cross-bedded stream gravel, such as occurs in many parts of Oklahoma and adjacent states, being made up of rounded and sub-angular, water-worn pebbles, varying in size from fine sand grains up to those four and six inches in diameter. The great majority of the pebbles, however, are small, being less than one inch in diameter. The material is largely igneous rock, such as granite, diorite, and the like, which make up the great mass of the Wichita Mountains some twenty to thirty miles to the north. Most geologists who have visted the region believe that the greater part of the material came originally from the mountains. The gravel varies in thickness in different parts of the ridge from a few feet up to something like twenty feet. At the pit where the bones and artifacts have been found, the upper 3 to 5 feet is composed of soil, beneath which there is a gradation from soil to the undisturbed gravel. The gravel itself is here ten to fifteen feet thick. Near the bottom of the quarry, and just above the top of the red beds upon which the gravel beds rest, there is a zone of indurated or hardened material, probably caused by the water percolating through the loose gravel until its flow has been checked by the impervious red clays beneath.

Geologists who have studied the problem believe that the gravel beds now on the top of the hill north of Frederick represent an old river channel which, during Pleistocene times, found its way from the Wichita Mountains southward toward the present site of Red River. If this is true, the ridge which is now 100 feet above the surrounding plains must have been a valley. While there is no means of knowing how high the hills stood on either side of this valley at the time when the gravel beds were laid down, it is reasonable to suppose that the general level of the region was at least 50 to 100 feet above the present gravel beds. If this is true, the general region must have been eroded as much as 150 feet.

According to Mr. A. H. Holloman, the owner of the gravel pit, the bones, metates, and arrowheads have been found scattered here and there throughout the lower half of the gravel. The first scientists to

examine this gravel pit were Messrs. J. D. Figgins and Harold Cook, of the Denver Museum, who visited the quarry in January, 1927, and took away with them the metates, arrowheads, and many of the bones. These articles are now in the Denver Museum. Since that time a number of scientific men have examined the deposits, including Dr. Oliver P. Hay, of Washington, D. C.; Professor Albert Jenks of the University of Minnesota; Professors C. E. Decker, Leslie Spier, A. O. Weese, A. I. Ortenberger, and the writer from the University of Oklahoma. So far as I am aware, all of the scientific men who have visited the gravel bed are in accord as to the facts as stated above.

The point at issue seems to have been as to the actual finding of the bones and artifacts in the undisturbed gravel, and the possibility that these materials might have worked their way down through crevices from the surface. The bones and artifacts have all been found by the owner of the pit, Mr. Holloman, during the course of his excavations in the quarry, and no scientist, so far as I am aware, has seen these objects *in situ*.

About September 19, 1928, Mr. Holloman found an arrowhead in place in the undisturbed, cross-bedded gravel, 13 feet below the surface, and Mr. A. H. Krause of Frederick, a long-time friend of the writer, went immediately to the quarry and took several photographs of this arrowhead before it had been removed from the matrix These photographs were sent to Norman, and on October 5, Professors Spier, Weese, Ortenberger, and myself, all from the State University of Oklahoma, drove to Frederick and spent October 6 in the pit. We took additional photographs of the place from which the arrowhead had been secured. There is no doubt in my mind that the gravel where the arrowhead was found had been undisturbed since the time of its deposition in Pleistocene times, and there appears to be no possibility that the arrowhead could have found its way downward along crevices from the surface.

I know of no criteria other than that of fossils which would give a clue to the time which has elapsed since this river gravel was laid down. Probably Mr. Harold Cook's estimate of 365,000 years, as recorded in Scientific American for August, 1927, is as nearly accurate as any estimate that may be made.

BOTANY.—*A new* Maurandya *from Arizona.*[1] FRANCIS W. PENNELL, Academy of Natural Sciences, Philadelphia, Pa. (Communicated by T. H. Kearney.)

In the spring of 1928 Mr. Robert H. Peebles discovered an unfamiliar plant growing on rocky ledges in the canyon of Fish Creek, a tributary of Salt River, at the eastern extremity of Maricopa County, south-central Arizona. After a vain effort to identify it among the specimens of *Maurandya* in the United States National Herbarium, Dr. T. H. Kearney, of the U. S. Department of Agriculture, who was with Mr. Peebles when the plant was gathered in flower on April 1, forwarded flowering and fruiting material to me with the suggestion that I should describe the species, if it prove new to science.

Inspection of the two collections at hand has shown Dr. Kearney to be fully justified in suspecting that this is an undescribed species of *Maurandya*. It must look very different in the field from any other species of this genus in the United States. Forming short thick tufts with stems scarcely or not twining, with leaves that are widely cordate and less cleft or jagged, and with yellow rather than purple corollas, the plant is but distantly akin to these. Its only close relationship is with the recently discribed *M. flaviflora* Johnston[2] of Lower California; together they constitute a natural section of *Maurandya*, but the following contrast shows that between them there are many distinctions:

Stems slender; leaf-blades shallowly dentate, the teeth again serrate; fruiting pedicels curving until contorted; corolla 25–28 mm. long, the posterior lobes longer and arched; stamens exserted; seeds 2 mm. long. *M. flaviflora*
Stems stout, thick; leaf-blades palmately lobed, the lobes entire; fruiting pedicels merely recurved; corolla 20–22 mm. long, the lobes all uniform and spreading; stamens included; seeds 1–1.5 mm. long. *M. acerifolia*

Maurandya acerifolia Pennell, sp. nov.

Perennial, forming loose mat-like growths; glandular-villous throughout. Stems becoming thick, much branched, white-villous below. Leaf-blades mostly 1.5 cm. long, 2.5 cm. wide, broadly cordate or reniform, obtuse, with about 7 broadly triangular, sharp or rounded lobes; petioles slender, straight, 1.5–2 cm. long. Pedicels slender, in anthesis 10–20 mm. long, in fruit becoming thicker and recurved. Sepals in anthesis 6 mm. long, triangular-ovate, in fruit slightly accrescent. Corolla 20–22 mm. long, pale yellow, cylindric, two-ridged within anteriorly but lacking a palate, externally nearly glabrous, internally finely pubescent on all sides at base and over bases of filaments, distally glabrous except for the two anterior ridges, these

[1] Received December 31, 1928.
[2] Proc. Calif. Acad. Sci. IV. **12**: 1162. 1924.

densely pubescent with flat yellow hairs; lobes uniformly spreading, all ovate-orbicular, 4–5 mm. long. Stamens included, didynamous; filaments finely pubescent near base, distally glabrous or with a few tack-shaped glands; anthers 1–1.2 mm. wide, the cells circular. Style slender, glabrous. Capsule globose, 8 mm. long, each cell opening loculicidally by distal ruptures, the septum and adjacent capsule-walls persisting, the placentae evident as central aggregations of short knobs. Seeds 1–1.5 mm. long, gray or blackish, with corky longitudinal ridges.

Type in the United States National Herbarium, collected in rock crevices, Fish Creek Canyon, eastern Maricopa County, Arizona, in flower, April 1, 1928, by R. H. Peebles, G. J. Harrison and T. H. Kearney (no. 5246). Also gathered in fruit at the same locality, April 22, *Peebles & Harrison* 5286. Dr. Kearney informs me that the locality is "in the canyon of Fish Creek about one mile above the confluence of that stream with Salt River, and a few miles below the Roosevelt Dam."

The specific name *acerifolia* has been chosen because the leaf-blades suggest those of maple, the palmate lobes being prominent, although the intervening sinuses rarely extend a third of the distance from the tips of the lobes to the base of the blade.

BOTANY.—*Plants of Lower Californian relationship in central Arizona.*[1]

THOMAS H. KEARNEY, Bureau of Plant Industry.

In the preceding article, Doctor Pennell describes a new species of the Scrophulariaceae (*Maurandya acerifolia*) from Fish Creek Canyon, near the center of Arizona, and points out that its nearest relative is *M. flaviflora* Johnston, a species known only from Las Animas Bay, on the eastern coast of Lower California nearly half-way down the peninsula. The fact is noteworthy in view of the occurrence in and near Fish Creek Canyon of a shrub belonging to the Rhamnaceae, *Colubrina californica* I. M. Johnston,[2] which is not known to occur elsewhere than at Las Animas Bay and another locality near the middle of Lower California.

The occurrence in this part of Arizona of two plants of widely different botanical relationship, one apparently identical with and the other closely related to a species inhabiting Lower California, constitutes a puzzling problem in geographical distribution. Neither the *Maurandya* nor the *Colubrina* have fruits and seeds that appear to be adapted to dissemination by birds. One can only guess at an explanation of the occurrence of this minute "islet" of plants of Lower California affinity so many hundred miles to the northeast, in the interior of Arizona. Assuming that the same forms, or nearly related

[1] Received December 31, 1928.

[2] Proc. Calif. Acad. Sci. IV. **12:** 1085. 1924. Dr. Johnston has confirmed the identification of the Arizona specimens of this *Colubrina* and states that they differ from the Lower Californian plant only in the size of the fruits.

ones, are absent in the intervening territory, an explanation of this anomalous distribution must be sought in the geologic history of the region.

The climate and topography of the Arizona–Sonora–Lower California region doubtless have changed considerably during or since the Tertiary. It is believed that in Pliocene or Pleistocene time, the Gulf of California extended considerably farther north, and perhaps northeast, than at present. Ross[3] has suggested that the calcareous beds of the lower valley of the Gila River may "mark the northern limit of this incursion of marine waters."

Perhaps these species of *Colubrina* and *Maurandya* are relics of a flora once continuously distributed around the shores of the ancient gulf, the remains of which have become separated by increasing aridity in northwestern Sonora and southwestern Arizona. The recent discovery, in Yuma County, Arizona, of a palm of the genus *Washingtonia* (*W. arizonica* Cook) nearly related to the fan palm of the western side of the Colorado Desert (*W. filifera Wendl.*) may be regarded as additional evidence of rather profound changes in the climate and topography of this region.

SCIENTIFIC NOTES AND NEWS

Nathan W. Bass has resigned as geologist with the U. S. Geological Survey to accept a position on the staff of the Pure Oil Company with headquarters at Tulsa, Oklahoma.

Charles E. Erdmann has been transferred from the Geologic Branch of the U. S. Geogical Survey to the Conservation Branch and assigned to the Denver office.

Dr. William Bowie, Chief of the Division of Geodesy of the U. S. Coast and Geodetic Survey, has recently been elected a corresponding member of the Academy of Sciences of the Institute of France.

Mr. H. W. V. Willems of Delft, Holland, has been spending some months in the Chemical Laboratory of the Geological Survey studying methods of analyzing rocks. After some time in the Geophysical Laboratory Mr. Willems expects to spend five years in Java in connection with geological and petrographic investigations in the Dutch East Indies.

The Department of Geology of the United States National Museum has recently added to its collections a large platinum nugget, associated with chromite and weighing over 17 troy ounces, from the Chocoya River, Colombia. A large section of a pegmatite from Newry, Maine, showing large "watermelon" tourmaline has also been acquired. An unusually fine cut blue topaz from Maine has been added to the gem collection.

[3] Clyde P. Ross. *The Lower Gila region, Arizona.* U. S. Geol. Surv. Water Supply Paper 498: 31. 1923.

Obituary

Dr. JOSEPH GOLDBERGER, Director of Field Studies in Nutrition, U. S. Public Health Service, and a member of the ACADEMY, died January 17 in Washington from an undetermined disease contracted during the course of his work. Dr. Goldberger was born July 16, 1874, in Austria-Hungary, received the degree of Doctor of Medicine from New York University in 1895, and entered the Public Health Service in 1899, becoming Director of Field Studies in Nutrition in 1914. He contributed materially to the study of several epidemic diseases, but was best known for his investigations into the cause and treatment of pellagra.

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GENERAL SCIENCE.—*The lingering dryad.*[1] PAUL R. HEYL, U. S. Bureau of Standards.

There is an every day test which we all instinctively apply when we are in doubt whether a certain thing is alive. We watch for it to move. This is a test as old as humanity, though as we now apply it we introduce a logical refinement which was lacking in other days. Absence of motion, now as then, indicates absence of life, but the mere observation of motion does not always suggest to modern thought the presence of life. A sheet of paper may be rustled by an invisible breeze; stormy waves may arise in the ocean; the ground beneath our feet may tremble and split open; yet we of to-day see in such phenomena no reason for assuming life as a cause.

Not so with the ancients. To them motion invariably suggested life, directly or indirectly involved. The sheet of paper, of course, was not alive, but the wind was the breath of Aeolus. The stormy sea was the direct physical result of the wrathful strokes of Neptune's trident, and the heaving earth, by the same token, gave evidence of the displeasure of Poseidon, the earth-shaker.

While the mythology of the ancients contained much that we now regard as childish and ridiculous, there is also to be found in it that which we must still recognize as beautiful, such as the myth of the dryad.

The dryad was a tree nymph. Every tree had its protecting spirit who was born with the tree, lived in or near it in intimate association, watching over its growth, and who died when the tree fell. The dryad was thus a personification of the life of the tree, and the connection

[1] Presidential Address before the Philosophical Society of Washington, January 5, 1929. Publication approved by the Director of the Bureau of Standards of the U. S. Department of Commerce. Received January 5, 1929.

between nymph and tree was far more intimate than was the case with the deities dominating sea or wind. Because of this peculiarly intimate relation the tree possessed life which the sea did not, though Neptune inhabited its depths, and which the wind did not, though set in motion by Aeolus.

The men of old, it seems, drew very much the same distinction that we do when we speak of living and non-living substances. Water, they observed, never grew old or died, but a tree was obviously a living thing, almost one of us, growing, reproducing its kind, and eventually dying. And as the ancients had difficulty in forming an idea of life without an animating personality there arose naturally the concept of the inseparable tree nymph.

Human thinking from the first has been frankly anthropomorphic. Only in modern times has there been any notable effort to cast out anthropomorphism from our philosophy, and this struggle has not yet resulted in victory. Even we of to-day, with hereditary habits of thought heavy upon us, find the concept of impersonal, physical causes drab and unsatisfying, and we spell Nature with a capital N. The dryad lingers.

In the chemistry of other days we find an interesting case of the persistence of this mode of thought. The old alchemists knew that wine by boiling lost its intoxicating power. Because they could see nothing escaping they said that the "spirit of wine" had found its abode too hot for it, and had taken its departure. Cassio used no figure of speech when he apostrophized the "invisible spirit of wine" by which he had been so disastrously possessed of the devil, and the name "spirit" as applied to alcohol is still in common use.

With the advance of knowledge it was found that many other phenomena beside intoxication owed their causes, not to spirits or devils, but to inanimate, prosaic chemical compounds. So strong, however, is heredity that the dryad, instead of disappearing from human thinking, merely changed her form and retreated under fire to a position of advantage across a natural barrier, where she long remained in safety.

It was many years before this barrier was crossed. The dividing line between organic and inorganic substances was a sharp one in the eighteenth century, and from her safe refuge in the domain of organic chemistry the dryad long watched her baffled foes. The older chemists divided the province of their science in two by a water-tight partition. All compounds with which they were acquainted could be

analyzed or broken down into their elements, but not all of them could be built up again by human skill. Water might be formed from its constituents, but not sugar or starch; yet these latter substances were daily synthesized in the laboratory of Nature, in the tissues of animal or vegetable matter; and, because they were never known to occur in mineral or inorganic matter, substances of this type were called from their origin, organic compounds.

Years of experience had given rise to the belief that there existed between these two classes of bodies a difference in kind rather than in degree, and that there was some reason not understood why organic compounds could not be synthesized artificially. This unknown reason was given a name; it was called the "vital force."

It often happens that when the unknown is named it appears as if it were more than half explained. The vital force once named soon came to be a familiar concept. It was held to be resident in living matter, whether animal or vegetable, much like the dryad in the tree. It was believed to differ in kind from the chemical and physical forces that governed the formation of inorganic compounds. Under the influence of this vital force it was believed that all the chemical reactions of living matter took place, and it was even supposed to govern the decompositions that occurred after death.

The belief in a vital force of this nature was universal among 18th century chemists, even Berzelius being found among its adherents. The vital force seems to have been regarded with something like the awe inspired by the supernatural, and it was well into the 19th century before its hold on men's minds began to relax.

The past year 1928 marked the century of an epoch in human thought, for it was just one hundred years since the doctrine of a vital force received its logical death blow. In 1828 Wöhler succeeded in producing by laboratory methods the first organic compound. This was urea, which he prepared by simply heating an inorganic compound, ammonium cyanate, containing the same elements as urea, namely carbon, hydrogen, oxygen and nitrogen, and in the same proportions.

This was a body blow at the dryad, but she died hard. Her devoted adherents rallied to her support and explained away Wöhler's result in various fashions. In this they were aided by the fact that for years this synthesis stood alone, suggesting that there was something exceptional about it. Some said that this proved merely that a mistake had been made; that urea was not really an organic substance, but occupied a place half way between the organic and inorganic king-

doms. Others argued curiously that the carbon of the cyanate retained some trace or memory of the vital force which had ruled it when it had previously been a part of some organic compound. But in time other syntheses were achieved in such numbers that the accumulated evidence became overwhelming, and it was finally recognized that organic chemistry was only complicated inorganic chemistry, and that the difference between the two was one not of kind, but of degree of complexity.

We have said that the dryad died hard. As a matter of fact she did not die at all—she emigrated. Dispossessed by the advancing frontier of knowledge from the domain of organic chemistry which had so long afforded her a refuge, she retreated under fire into a less understood region beyond—into the biological sciences. Here the complexity of phenomena was (and still is) so great that among the shadows the dryad still finds a retreat.

Biologists of to-day are divided into two camps—vitalists and mechanists. Between them a conflict rages, and the fate of the dryad still hangs in the balance. The vitalists argue that whatever may have been the case in the past we have now, by the progress of our knowledge, reached a dividing line which really marks a difference in kind; that there have been brought to light in the realm of biology phenomena of such a nature that they are not explainable by ordinary chemical or physical principles; that it is necessary to assume a principle peculiar to living matter (in other words, a "vital force") to explain them. Let us select what is perhaps an extreme case in illustration.

Food taken into the stomach of man and other animals is digested by means of the gastric juice. Some of this food is meat (all of it in the case of certain animals), muscular tissue like that of the stomach itself. The question naturally arises why the gastric juice does not digest also the wall of the stomach. Is it not like trying to dissolve a piece of zinc in acid contained in a zinc vessel?

It is not easy to answer this question. It cannot be due in any way to mastication, for if a piece of meat is swallowed without chewing the stomach will eventually digest it. It cannot be argued that cooking accounts for the difference, for this is an art practised by man alone, and is a comparatively late acquisition on his part. And in the face of the use of tripe as an article of food it cannot be that the stomach contains a protective substance which other muscular tissue does not possess.

There seems to be no difference between the stomach and the food

other than that the stomach is alive and the food dead, whatever this may mean; and even this explanation is hard pushed by the fact that the food of carnivorous animals under natural conditions usually reaches the stomach of the captor in a very short time after the death of the prey, an interval measurable almost in seconds.

By considerations such as these the controversy between the vitalist and the mechanist is kept alive. The vitalist maintains that between the phenomena of the living and the non-living there is a difference in kind, not merely in degree. Just what this difference may be he is not prepared to say, but he maintains its existence. The mechanist, on the other hand, says that exactly the same arguments have been advanced in the past in connection with problems that seemed just as insoluble, and that these arguments have finally been disposed of by the progress of our knowledge. Differences in kind, once regarded as numerous in Nature, have slowly and steadily been resolved into differences in degree. Sharp lines of demarcation have been wiped out until the line between the living and the non-living is perhaps the only one left. Such diverse phenomena as those of electricity and light have been found to be closely akin; man himself has been shown to be one with the rest of animated Nature; and if the past is any guide to the future, it seems that even this last sharp line will some day disappear also.

Perhaps the vitalist himself may not realize it, but to the student of the philosophy of history this vague "difference in kind" suggests the last lingering trace of what was once a dryad. As a cloudlet dwindles and disappears in the beams of the sun, so the dryad has shrunk to a mere wisp of vapor, which with a little more light seems destined to disappear forever.

But now that we have finished pointing out the mote that is in the biologist's eye, let us examine our own clarity of vision. Are we physical scientists in any measure responsible for the lingering of the dryad?

By the latter half of the nineteenth century physical theory had become a well knit, sharply crystallized and self-sufficient body of doctrine. While it was recognized fully and generally that much was as yet unknown, it was felt quite as generally that what had been established would, with perhaps a little amendment and modification, stand forever. The physical theory of the last century was much admired by its devotees, upon whom it reacted in turn to the extent of making them at times a bit dogmatic. If there was a conflict between physics and a sister science, physics must be right.

The classical instance of this attitude is the famous controversy over the age of the earth, between the physicists on the one hand and the geologists and biologists on the other. Perhaps nothing in the annals of nineteenth century physics made such an impression upon the sister sciences. This controversy lasted for 33 years with unabated vigor, and was not finally settled until the discovery of radioactive substances.

In 1862, upon the basis of the laws of the conduction of heat as laid down by Fourier, Kelvin calculated that the time that had elapsed since the earth had solidified from a molten state could not be less than 20 millions or more than 400 millions of years. He admitted that rather wide limits were necessary, but was inclined to attach more weight to the lower figure than to the higher. In this he was confirmed by a similar calculation made by Helmholtz of the age of the sun.

At this estimate biologists and geologists stood aghast. The prospect of having to pack into a paltry 400 million years the whole progress of organic evolution from amoeba to man seemed to biologists unreasonable. And with the geologists the situation was still worse. It was generally recognized that a very long period of time must have elapsed after solidification before life of the most primitive form made its appearance, and this period, in addition to that required by evolution, must be made to fit Kelvin's Procrustean bed. Moreover, it was felt by geologists that such a view involved a return to eighteenth century ideas, from which geology was just beginning to emerge.

Prior to the nineteenth century geological thought was of the catastrophic school. It was held that natural forces were more active and powerful in past geological ages than they now are; that great convulsions of Nature had riven the crust asunder into valleys and elevated other portions into mountains. By the middle of the nineteenth century the opposite, or uniformitarian school of thought had achieved the ascendency, largely through the influence of the geologist Lyell. On this view it was held that geological processes had never differed seriously from those of the present day. As a consequence of this doctrine an immense antiquity was required for the earliest geological strata, and with this almost unlimited time at their disposal biologists felt unhampered.

Then came Kelvin's bomb shell. Protest and appeal were not lacking, but Kelvin was inexorable. Physics, he said, could grant no more, and physics held the power of the purse of time.

The widespread and long continued interest in this controversy is evidenced by the many letters published on the subject in "Nature" from January to April, 1895. As proof of the fact that Kelvin did not stand alone in this matter it is of interest to note that not a single physicist failed to support him in theory, though there was a general feeling that perhaps his limits might be widened somewhat. The discussion was finally summed up by its initiator, Professor John Perry, who expressed the opinion that the upper limit assigned by Kelvin might perhaps be multiplied by four. But this concession brought about no *rapprochement*. The two sides were not near enough to dicker.

A few years later the deadlock was finally resolved by the discovery of radioactivity. This new and totally unexpected source of terrestrial heat nullified Kelvin's fundamental postulate, and allowed as much time as the most extreme views could require.

Rightly or wrongly, this celebrated case had an unfortunate effect upon inter-scientific relations. The biologists in particular felt that the character of their problems and the evidence for their conclusions were not appreciated by the physicists. The impression was gained that physics was for some reason incompetent to treat of biological questions, and that the life sciences required for their complete discussion and development something that was not and could not be found in physical theory. It may scarcely be doubted, I think, that this impression of the inadequacy of physics went far toward strengthening and prolonging the life of the vitalistic hypothesis.

But, to be fair, we must recognize that the vitalism of to-day is not that of a century ago. To use a term borrowed from mineralogy, it is but a pseudomorph of its predecessor, cast in the mould of the older form, and simulating its outward shape, but inwardly of a different composition. The neo-vitalist of to-day disclaims utterly anything savoring of the occult or the supernatural; short of this, he is ready to accept any adequate explanation of life. He maintains, however, with equal firmness that even modern physical theory lacks something necessary to explain vital phenomena; that no interplay of atoms, however complicated, can account for the simplest manifestation of life. In brief, the vitalist looks outward for the explanation of life; the mechanist looks inward.

The attitude of the mechanist is, for the present, largely one of faith and hope rather than sight. He admits that modern physical theory affords no explanation of life, and that there is no reason to believe we

are any nearer a solution now than we were a century ago. But, encouraged by precedent, he holds steadily his faith that some new and unexpected discovery may at any time clear our vision as radioactivity clarified that of our predecessors. And he is confident that when the solution of this mystery is reached it will be found to be internal rather than external.

But while we are waiting for something of this kind to happen, may we by any chance find some foreshadowing of a possible common ground in existing physical theory?

Let us imagine, if we can, some one whose physical experience has been limited to solids and who is ignorant of molecules and atoms. The latter will not be so difficult when we remember that it has not been so very long ago that we were all ignorant of any sub-atomic structure. Matter, to our supposed observer, is continuous and infinitely divisible without alteration in its properties; its structure is perfectly uniform to the last conceivable degree. Suppose further that he observes for the first time the melting of a solid. That which would probably impress him most in this process would be its abruptness, its sharp initiation. By continual influx of heat the solid suffers a steady rise of temperature, which seems as though it might continue indefinitely as long as heat is supplied. But suddenly, without warning or apparent cause, a critical point is reached. Though the influx of heat is not halted the temperature stops rising. A new effect is seen, different in kind from any phenomenon known in solids. We say that the body is undergoing a change of state and is becoming a liquid. In this new state new laws govern its behavior; new properties are evident, differing in kind, not in degree, from those of solids.

Our unsophisticated observer might well wonder at this curious behavior; but should we, from our superior knowledge attempt to tell him that this difference in appearance and behavior is not a matter of composition or outside forces, but of internal structure, we might find him rather incredulous.

"No," he might say. "Something has happened to stop the rise of temperature. There has been an introduction of a new factor into the situation. You speak of structural difference. I do not understand you. The structure of a solid, as I am familiar with it, could not be more simple than it is—continuous, infinitely divisible, uniform throughout, with no shade of difference anywhere upon which to build up an explanation. No; we must look outside for the cause of this change. Liquid phenomena are not expressible in terms of the properties of solids. He who maintains that they are is a mechanist."

In this belief he might be confirmed if he pushed the heating of the liquid far enough. At a second critical point, again unheralded and without apparent reason, the liquid begins to boil, and the resulting gas exhibits a new set of phenomena, differing in kind from anything to be found in either solids or liquids. The new phenomena in this case depart even more widely from those of the other states than was the case at the first critical point.

To us, with our knowledge of molecules, the explanation of these critical points and different states is comparatively simple and internal. It is true that the phenomena of one state are not to be expressed in terms of the properties of another; the behavior of gases cannot be deduced from the laws of elastic solids or of incompressible liquids. The solution does not lie in a line joining one state to another, but goes back from each state to the common basis of molecular structure underlying all states, something of which our observer is yet to become aware. And until a similar common ground for the phenomena of living and non-living matter is recognized there must be a difference of opinion between the vitalist and the mechanist.

What this common basis may be we cannot as yet surmise. It remains for some new discovery to open our eyes. It must be something deeper and more fundamental than molecules or atoms. In so far the vitalist is right; and in so far as he maintains that the mere interplay of atoms contains the key to the mystery, the mechanist is wrong. But such a common basis, underlying and forming part of non-living as well as living matter, would be an internal factor, and it is for such a factor that the mechanist is looking.

The parallel here suggested is worth pushing farther. The past history of Nature has been one of change, of growth, of that development which we call evolution. Her future, if hindsight is to be trusted, will carry this evolution onward to a consummation of which we can as yet form no conception. Nature, we may say, has been steadily warming up to her work since the beginning of things. And in this warming up process we may distinguish several critical stages, strangely suggestive of the different states of matter.

The first of these critical points was reached millions of years ago, when life first made its appearance, a totally new phenomenon superimposed upon inanimate Nature. For untold ages life was impossible on the earth, but eventually, when conditions allowed, life appeared, no one knows how. With its appearance a new order of things was introduced, and phenomena not to be found in inorganic Nature began

to show themselves. With the advent of the organic, new motives of action are recognizable, and new combinations are possible. The vitalist explains this by bringing in a mysterious something from the outside; the mechanist is persuaded that matter in acquiring life has not ceased to be a conservative system; only in its behavior is it transformed.

Moreover, this transformation has not been complete. Living and non-living matter exist side by side and will probably continue to do so. The physicist would call this the co-existence of two phases at one temperature, like a mixture of ice and water at the freezing point, each following its own laws and exhibiting its own characteristic properties under the same environment.

We may, perhaps, by poetic license think of the first beginnings of life as feeling strange and lonely in the midst of the non-living matter surrounding them, so different in properties, in behavior. And perhaps we may imagine that the works and ways of non-living matter occasionally grated on the sensibilities of the living, and called forth the protest: "Why are you so mechanical? Why not show a little flexibility occasionally?" But this protest, we may imagine, was wasted. "It is my ancient way," replied non-living Nature, "the way I did for millions of years before you new-comers appeared upon the scene. I cannot mend my case. Why not do as I do and be sociable?"

But this is just what living matter will *not* do. Like white men in the tropics, it maintains its standard of living among an overwhelming majority of an inferior grade of civilization.

Millions of years have passed. Life is no longer a new-comer, a feeble colony, but has waxed mighty, and has become the outstanding feature of the earth's surface. And now we have reached a second critical point. Life has attained such a degree of complexity that a new set of phenomena is beginning to make its appearance, something different in kind from anything that has been before; as different in its turn as was life itself compared to inanimate matter; something superimposed upon life as life of old was superimposed upon the non-living. And it is, appropriately enough, in man, the highest type of life, the flower of creation, the peak of evolution, 'the heir of all the ages in the foremost rank of time,' that this new thing first makes itself manifest—a moral sense, an ethical feeling, which often finds itself as much a stranger in its environment as life

must have felt among the crystals and colloids among which it began its existence. If we must find a single word to express this new quality, let us call it Soul.

Within us is developing a new thing, as wonderful as life itself and no less rich in possibilities. Life in its turn has brought forth something of a higher order, transcending itself, as it once transcended non-living matter. And that this new thing has elected to make its appearance in and through us, the highest of Nature's children, what is more reasonable? Do men gather figs of thistles?

But here the vitalist takes his last stand. "I know," says he, "that past history points your way; that one step after another, I have been forced to give ground. I, who once held that no one but God could make an organic compound, have lived to see it done by high school students. You mechanists, on the other hand, have pressed steadily forward. But beware lest, flushed with success and intoxicated with power, you attempt too much and achieve your own downfall. What you tell me now goes beyond all bounds of credence. Am I to understand that all that makes a man, his ethics, his poetry, his music, his aspirations, his ideals, are from within? Are these, too, of the earth, earthy? Never! These, at last, must come from without. Can ideals rise higher than their source?"

Of the earth, earthy! But why should there be anything mean or unworthy about that which comes from within rather than from without? Is the macrocosm essentially nobler than the microcosm?

True, tradition runs that way. Man at different times has set his gods in the most inaccessible places, on the summit of Mount Olympus, or across the rainbow bridge in Asgard; but the greatest idealist that our race has produced broke with this tradition when he said: "The kingdom of God is within you."

And perhaps it may be true that ideals can rise higher than their apparent source. Just as every great genius had parents of less than his own ability, who yet in some mysterious way endowed him with more than they themselves possessed, so Nature has produced within us something without precedent in the life history of the earth. And as a parent watches with pride a child who gives early promise of outdistancing his elders, so Mother Nature may be watching us.

What is this new thing which Nature has brought forth, and with the development of which we have been entrusted? No man can say, but it is a fair inference that it will go far. Life has gone far from a

tiny speck of protoplasm; who knows to what lengths this new thing, this mind, this soul, if you will, may carry us? For it doth not yet appear what we shall be.

PALEOBOTANY.—*A walnut in the Pleistocene at Frederick, Oklahoma.*[1]

EDWARD W. BERRY, Johns Hopkins University.

The specimen which is the subject of the present note is of considerable interest since it was found in a consolidated Pleistocene gravel associated with flint implements and the bones of extinct mammals. Comments by Spier, Hay, and others on the first arrow point found have appeared in *Science*, and the mammals will be described by Dr. Hay, to whom I am indebted for the opportunity of studying the walnut. The locality is about 1 mile north of Frederick in Tillman County, Oklahoma.

The nut is somewhat water worn, approximately spherical in form, being 1.9 centimeters high and 2.1 centimeters in diameter, and shows the long surface ridges of the existing *rupestris* group of forms. It is in marked contrast in this feature with the *californica* forms of the Pacific coastal region or with *Juglans nigra* of southeastern North America. The last has sharp and broken ridges, in even minimum sized nuts and is readily and certainly distinguishable from the fossil.

The typical *rupestris*, which still occurs in creek valleys around the Wichita Mountains in the immediate vicinity of Frederick, has much smaller nuts which are only about three-fourths the size of the fossil and with relatively broader ridges and narrower grooves. The more southern and western *Juglans rupestris major* has much larger nuts which are oblately depressed and laterally expanded. Its ridges tend to be broader and its grooves narrower than in the fossil. Typical specimens of *rupestris*, *rupestris major*, and the fossil with a portion of the consolidated gravel matrix are shown in the accompanying figures.

The present fossil form furnishes a good illustration of the difficulties attending the precise evaluation of a single specimen when its existing relatives integrade, and are not satisfactorily segregated by systematic botanists. The well known black walnut, *Juglans nigra*, a tree of deep rich and well watered soils, extends into eastern Oklahoma, where it is found in the Ozark plateau country, and southward over eastern

[1] Received January 4, 1929.

Texas to the San Antonio River. So far as known it does not occur naturally as far west as Tillman County.

The typical *Juglans rupestris* is present in stream valleys in southwestern Oklahoma, usually in soils derived from limestone country-rocks, and in similar situations in northern and western Texas. *Juglans rupestris major* occurs disconnectedly from Tarrant County, Texas, (Sudworth) westward across southern New Mexico and Arizona and into northern Mexico. It is a more distinctly arborescent form than *rupestris* and is confined to disconnected stations of richer moister soils of canyon bottoms. Where the ranges of the two forms overlap in Texas intermediate forms are said to occur, but the question has not been critically studied. I have assumed[2] that *major* was the ancestral

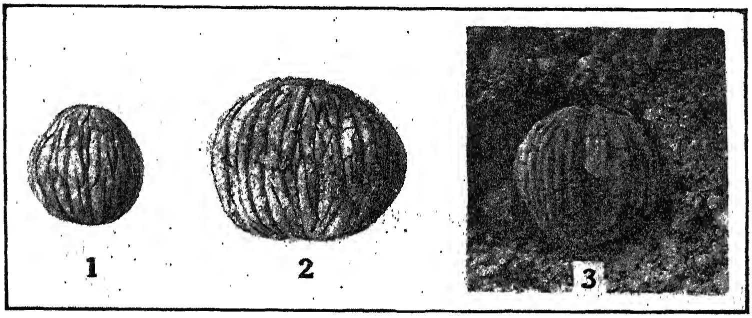

Fig. 1. *Juglans rupestris* Engelmann.
Fig. 2. *Juglans rupestris major* Torrey.
Fig. 3. *Juglans rupestris pleistocenica* Berry.

form which at the present time is confined to relict environments, and that *rupestris* is the derivative form evolved during the progressive desiccation of the southwest.

The fossil, intermediate in size between the two, might be interpreted as standing midway between them in the assumed evolutionary series mentioned in the preceding paragraph. Verification would depend upon more specimens of the fruit as well as a knowledge of the foliage and general habit of the tree, which we are not likely ever to acquire. The fossil might also be considered as affording evidence of a somewhat more mesophytic climate at the time it was living in southwestern Oklahoma. Such a conclusion, however, would be justified only by finding it abundantly distributed with appropriate associated forms, since the well known habit of *Juglans* of retreating to

[2] EDWARD W. BERRY. Am. Mus. Nat. Hist. Novitates No. 221. 1926.

favorable stream side habitats in regions where the general climate is unfavorable, notably shown by the existing California species and also by the two existing southwestern species immediately concerned in the present discussion, completely invalidates the attempt to draw any far reaching conclusions from the fossil occurrence. This is shown by the gravel matrix, apparently a stream deposit, indicating that the parent tree must have been a stream-side form, although we can not tell whether it was confined to such situations.

Regarding the age of the deposit it may be pointed out that any attempt to arrive at the relative age of the fossil is rendered impossible, since estimates in the absence of age determinations based upon independent criteria rest on the distribution of the most closely allied living forms and the probable rate of change of climatic and other factors governing the change of range. These fail in the present case, since *rupestris* is still found in the immediate vicinity, *major* a relatively short distance to the south, and *nigra* a relatively short distance to the east. Accordingly to Dr. Hay the associated mammals indicate an early Pleistocene age.

In order to distinguish the fossil form from the two nearest living forms, at least until such time as systematic botanists shall have satisfactorily determined their status, I have given it the varietal name **pleistocenica**, without, however, meaning to imply that it is necessarily an extinct variety. This can not be determined satisfactorily from the present evidence.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

PHILOSOPHICAL SOCIETY

977TH MEETING

The 977th meeting was held at the Cosmos Club, October 13, 1928.

The program consisted of a symposium on the constants of nature.

P. R. HEYL: *Gravitation.* The constant of gravitation is one of the few natural constants that cannot be expressed in terms of anything else. The best value obtained for it at present (Bureau of Standards, 1927) is 6.664×10^{-8} in c.g.s. units.

It is known that this constant is independent of the nature of the material to a high degree of accuracy. Eötvös by the torsion pendulum has proved that for ordinary materials this is true to 6 parts in 10^9. For radioactive substances, where the amounts available for experiment were smaller, the precision reached was less. It is also known that this constant is independent of the temperature to 1 part in 10,000.

Einstein's theory of gravitation makes possible the speculation that this

constant may be a function to a slight extent of the masses involved in the gravitative action; also that the constant may vary slightly when relatively small distances are considered. (*Author's abstract.*)

W. D. LAMBERT: *Geodetic data.* (Published in full in this JOURNAL **18**: 571. 1928.)

W. J. PETERS: *Terrestrial magnetism.* The generalized magnetic field of the earth may be ascribed to the combined effect of three agencies, one within the earth possessing a potential and accounting for 94 per cent of the earth's total field, another around the earth outside also possessing a potential, and a third having no potential.

The coefficients of the series of solid spherical harmonics expressing the potentials are known as Gaussian constants. There are three of the first order which have a simple physical meaning. The terms containing them represent for the inner field the potential arising from the uniform magnetization of a sphere, the earth, parallel to a fixed axis. The magnetic moment corresponding is 8.04×10^{25} c.g.s. which was decreasing during the last 80 years by 1/1500 part annually. For the outer field the moment is only 0.14×10^{25} c.g.s. The point where the fixed axis pierces the earth's surface in the northern hemisphere is in latitude 78° 32′ north and longitude 69° 08′ west of Greenwich. For the outer field the fixed axis pierces the surface in the northern hemisphere in latitude 75° 48′ north and longitude 121° 24′ west of Greenwich. The other ends would pierce their antipodes. Neither axis passes through the magnetic poles which are in latitude 70° 50′ north and 96° 00′ west longitude and in 71° 10′ south latitude and 150° 45′ east longitude respectively. That is, the magnetic poles are not quite diametrically opposite but each is about 2300 kilometers from the antipode of the other.

The axis of the inner field is moving slowly, the north end towards the west and the equator.

Besides the constants of higher orders in the analyses of the two fields having a potential there are others awaiting confirmation and physical interpretations. Especially problematical is the field having no potential, which at present can only be explained by the existence of vertical currents of electricity passing through the earth's surface of about 10^{-11} amp/cm^2, whereas the observed currents of atmosphere are too small to be detected by the methods of Terrestrial Magnetism.

In order to study magnetic disturbances, particularly those of long period, it is necessary to devise some suitable measure of the disturbance or magnetic activity of the earth. For this purpose 40 observatories have gotten out the so-called character-numbers for each day (beginning Greenwich midnight) graded according to the intensity of disturbance as it appears to the unaided eye looking at the three curves usually registered, as 0, quiet; 1, moderately disturbed; 2, greatly disturbed. They are not constants nor do they depend on any constant.

The magnitude of the diurnal ranges in declination is apparently a function of the magnetic dip and sunspot-numbers involving constants. Both the form of the function and the magnitude of the constants are as yet but approximately known.

The secular variation is another quantity the value of which is but approximately known. It appears to be a function of space as well as time. Attempts have been made to get expressions for it from Fourier series, but the results have not been very satisfactory. (*Author's abstract.*)

O. H. GISH: *Terrestrial electricity.*

L. H. ADAMS: *Geophysical data.*

978TH MEETING

The 978th meeting was held at the Cosmos Club, October 27, 1928.

Program: WILLIAM BOWIE: *The stability of the earth's crust as tested by triangulation.* Practically all land areas of the earth have been below sea level at some time in the distant past, hence their present exposure is due to a change in elevation. This change has involved thousands of feet in many instances. There are also evidences of great horizontal movement as is indicated by buckled strata and overthrusting. The question is frequently asked, by students of the earth, at what rate do the uplift and horizontal movement take place. These are problems which can only be solved by exact measurements on the ground. Changes in geographic positions over wide areas can be determined by triangulation and differences in elevation may be obtained by exact leveling.

At the request of the Chairman of the Committee on Seismology of the Carnegie Institution of Washington, Dr. Arthur L. Day, the Coast and Geodetic Survey began in 1922 a new triangulation of all the stations which coincide with those which had been established prior to 1898 in California. This triangulation extends from the Sierra Nevadas to the eastward of San Francisco westward to the coast, then along the coast to the mountains just to the eastward of San Diego. A short spur extends from the vicinity of San Francisco northward to Point Arena.

The old and the new triangulation were executed according to the generally accepted specifications for first order work. The angles in this class of triangulation were observed with such accuracy that on the average the sum of three angles of a triangle will equal 180° plus the spherical excess within about 1″. The maximum closing error of a triangle seldom exceeds 3″. Base measurements are made of sides of the triangles at intervals of about 100 miles or more depending upon the size of the figures to control the lengths of the arc of triangulation. Also Laplace stations, for which the astronomic azimuths are corrected for the deflections of the vertical, are placed along the arc of triangulation in order to prevent any swerving in azimuth of the triangle sides.

Triangulation was extended to the eastward of the two terminal points mentioned above, one into Nevada and the other into Arizona, to check the stability of the ground occupied by the terminal stations.

A readjustment of the triangulation net of the western half of the country, made a few years ago, furnished the basis for the study of the changes in geographic positions in California. These changed positions are due to two factors: first, the unavoidable errors of triangulation; and second, earth movements. Certain parts of the triangulation showed such small changes in position that no earth movements are indicated. The agreement of the old and the new angles for these apparently unmoved areas furnishes a means of testing angles along those parts of the triangulation where movements are indicated.

For instance, a comparison of the old and the new values for 254 angles in the unaffected regions showed that only six had differences greater than 2″ and no one angle had old or new values differing as much as 3″.

At some of the stations, in the vicinity of Pt. Arena, there were changes in angles as great as 26½″, also at stations between Mt. Ross and the vicinity of San Luis Obispo there were changes as great as 14″ in the angles. These changes were so large as to definitely indicate earth movements. It is

possible to use the results of the adjustment of the western half of the triangulation of the United States, involving 13,000 miles of arc, to determine the accuracy with which a distance is obtained from triangulation. The differences in the values for the lengths of sides of triangles, determined by the old and the new triangulation, can be compared with the accuracy with which distances can be obtained and, should the two differ greatly, earth movement would be indicated.

The greatest change in geographic position for any one station was 10.4 feet at Pt. Reyes L. H. The next largest one is at station Lane, 7.4 feet. That station is close to Pt. Arena. The third largest change is at station Santa Ana which is 6.5 feet. In general, the changes are in a southeasterly direction for the stations to the eastward of the San Andreas fault and the few stations which have northerly or northwesterly changes are on the western side of the fault. The general conclusion may be reached that no material change in geographic positions due to earthquakes has occurred at points used in the triangulation which are far removed from the San Andreas fault. The limiting distance for such movements is probably from ten to twenty miles. The exact distance is not known.

A study has been made of the old and of the new triangulation of California and the results of that study have been prepared in manuscript form for a special publication, No. 151, of the U. S. Coast and Geodetic Survey, which should soon be off the press. This publication may be obtained, by anyone interested, from the Superintendent of Documents, Washington, D. C. (*Author's abstract.*)

E. C. Crittenden: *A standard basis for heterochromatic photometry.* This paper reports two recent developments leading toward the acceptance of a standard method for comparing the visual intensities of lights of different colors. In attempting to establish such a standard method we face a dilemma; on the one hand, measurements of "light" mean nothing unless they represent effects on the eye and mind, while, on the other hand, the reaction of the eye to light is extremely variable. No absolute quantitative value can be assigned for any light. The best we can do is to assign relative values in comparison with some standard.

When the quality of the lights compared is different, even the relative values depend upon the observer and upon the methods of observation. In many practical measurements this difficulty is met by using filters to equalize the colors of the standard light and of the one to be measured, but in the calibration of these filters one must meet the fundamental difficulty. Definite values for the transmission of such filters can be given only by assuming definite conditions of measurement, of which some must be arbitrarily chosen.

Measurements on colored filters might be made by many methods, but only three are seriously considered. These are (1) the use of the standard Lummer-Brodhun contrast photometer, (2) measurements by flicker observations, (3) calculations by means of luminosity data involving spectral energy distribution for the source of light used, spectral transmission factors for the filter, and "visibility factors" which represent the relative sensibility of the eye to radiation of different wavelengths. This third method is far more complicated than the others, but when it is used all the physiological and psychological difficulties are hidden in the visibility factors. When these are agreed upon, the measurements remaining to be made are purely physical.

Visibility factors proposed by Gibson and Tyndall of the Bureau of Standards were provisionally adopted by the International Commission on Illumina-

tion in 1924, but there has remained some doubt as to the consistency of these data with the results obtained by the more direct methods of measurement. To settle this question and provide a uniform basis for measurements of colored light in this country, measurements have been made on a series of filters by different methods in several laboratories. These filters present a large range of colors, and deviations of individual measurements on some of them were large. Nevertheless, average results by all three methods mentioned above agreed very closely. This shows that the values adopted for the spectral visibility factors are concordant with direct observations of integral luminosity. Furthermore the several laboratories agreed more closely by the spectral method than by the direct methods of observation.

While the measurements mentioned were made on highly colored filters, the same difficulties have affected values for candlepower standards having colors less conspicuously different. For example, it is known that there are systematic discrepancies as large as 7 per cent between the candlepower ratings of electric lamps in different countries. Small changes in the efficiency of lamps have large effects on their life, and this 7 per cent difference in measurement of the light output would represent 40 per cent change in the length of service to be expected from the lamp at a given efficiency.

The satisfactory results of the spectral measurements made on filters by different laboratories in this country gave a basis for proposing definite recognition of this method by the International Commission on Illumination, which met in September, 1928. The Commission in effect recommended that the national laboratories follow this procedure in order to agree upon common units of candlepower for use throughout the world. Measurements are already in progress which it is hoped will bring about such agreement. (*Author's abstract.*)

979TH MEETING

The 979th meeting was held at the Cosmos Club, November 3, 1928, as a joint meeting with the Biological Society of Washington.

Program: SELIG HECHT: *The nature of the sensitivity of animals to light.* Most light-sensitive animals possess in common certain familiar properties: the capacity for light adaptation; the capacity for dark adaptation; an intensity threshold; a light and dark period in the duration of stimulus reception; and the ability to discriminate differences in intensity. From these similarities one may suppose that the organization of the photosensitive system which determines photoreception is fundamentally similar. An hypothesis has therefore been proposed in which a qualitative and quantitative representation is made of these and many other characteristics of photoreception. This system is a coupled photochemical reaction, and consists of two parts: first, a reversible photochemical reaction proper; and second, an ordinary chemical reaction which is catalyzed by the photolytic products of the first reaction. A definite amount of material is required to be formed in the secondary reaction in order to discharge the sense cell and to start an impulse in the attached nerve.

When intensity discrimination is studied in terms of this system it is found that for an animal to distinguish between one intensity and the next perceptibly different one, there is necessary a constant increment in the amount of photosensitive material decomposed in the sense cell. It is possible to describe this as an increase in frequency of discharge to the attached nerve, or as an increase in the number of sense cells functional in a given area.

The former makes it difficult to understand the discontinuity of intensity discrimination, whereas the latter involves the existence of a statistical distribution of thresholds among the sensory cells. Independent evidence from the relation between visual acuity and illumination shows that there is in reality such a statistical distribution of thresholds, the nature of which corresponds to the demands of intensity discrimination. It is therefore assumed that intensity perception is a function of the number of related receptor elements which are functional in a given area. It is, however, true that intensity discrimination, though discontinuous, possesses no critical points. And moreover, frequency of discharge in a given cell is an experimentally demonstrable function of intensity. It is therefore concluded that to discriminate one intensity from the next perceptibly different one, there must be produced in a group of related sense cells a constant increase in frequency of discharge, which is the result of the addition of one more functional element to those already functional. (*Author's abstract.*)

980TH MEETING

The 980th meeting was held at the Cosmos Club, November 10, 1928.

Program: FRANK NEUMANN: *The velocity of seismic waves over the Pacific regions.* The data consisted of seismographic records of the Honolulu magnetic observatory where two Milne-Shaw seismographs have been in operation since 1921. Because of its central location with regard to earthquakes in the Pacific region, records were available for earthquakes occurring at all points of the compass, and this fact is largely responsible for the most important result obtained in a recent investigation; namely, that under favorable circumstances the surface waves recorded at Honolulu can be definitely broken up into two major types—Love waves and Rayleigh waves. In twenty-seven cases, earthquakes recorded at or near cardinal points of the compass showed the transverse or Love wave dominant on one component only, and the Rayleigh wave on the other.

Love waves radiating from sources on the Pacific coast travel to Honolulu with a speed 20 per cent greater than that of the dominant Love wave group over the continent. Some records covering the region north of Honolulu show sharp activities at velocities corresponding to those which Jeffreys deduced for the two outer layers and the rock mantle of the earth's crust. The possibility that these activities were "beats" was discussed.

A slide was shown illustrating the method of studying all available records for the purpose of determining whether subsidiary activities definitely indicate the presence of surface layers over various paths of the Pacific basin.

The periods of Love waves increase with distance but may vary 50 per cent from the average value. The periods of Rayleigh waves cluster in groups which are multiples of ten seconds increasing to forty seconds at the greater distances.

From studies of the Honolulu seismograms and also other records, it appeared possible to determine something of the nature of the interior transverse or second preliminary tremor. The azimuth of the initial impulse of the so-called S wave at an observatory appears to be a function of the direction of the initial impulse at the origin of the disturbance. The following rule seems to apply: The azimuth of the impulse at the origin equals (1) The azimuth from the station to epicenter, plus (2) the azimuth from epicenter to station, minus (3) the azimuth of the S impulse at the station. All azimuths are counted from north around by east through 360°. Several diagrams were

shown to illustrate how the application of this rule yielded a common direction of impulse at earthquake origins. (*Author's abstract.*)

L. H. DAWSON, L. P. GRANATH and E. O. HULBURT: *The transmission of ultraviolet light through the lower atmosphere.* Measurements have been made of the attenuation of ultraviolet light in the spectrum region 4000 to 1860 angstroms by the atmosphere at sea level. The absorption coefficients were derived from spectra of a 1 kilowatt quartz mercury light taken at distances up to about 500 meters with a quartz spectrograph; suitable comparison spectra were impressed on each plate, and measurements of the line intensities were made with a recording densitometer. For wavelengths longer than $\lambda 3000$ no appreciable absorption could be observed at the distances used, and it was assumed that the Rayleigh molecular scattering law held for this spectral region. At shorter wavelengths pronounced absorption (above that attributable to molecular scattering) set in at about $\lambda 2800$, and increased with decrease in wavelength. The absorption was found to be the same for day and night and to be unaffected by changes in the humidity. It varied, however, with the visibility, getting greater as the visibility became poorer. The visibility was judged by the appearance of objects on a sky line seven miles away. The conclusion in general was that there is a relatively permanent absorption due to the atmospheric gases together with a changeable absorption due perhaps to particles, such as dust, water droplets, etc. For wavelengths below, say, $\lambda 2100$, oxygen seemed to be the most important cause of the absorption, but for wavelengths between $\lambda 2100$ and 2800 the exact origin of the absorption was uncertain. It may be due primarily to oxygen, but other gases such as ammonia, water vapor, oxides of nitrogen, etc., may have an appreciable influence. Apparently there is not enough ozone in the lower atmosphere to produce a noticeable absorption.

The absorption of the lower atmosphere was found to begin at about $\lambda 2800$, which is the wavelength region where the opacity of the high atmosphere commences (due to ozone at 50 km. or so). At $\lambda 2800$ the intensity of the light would be reduced to 1/10 in a distance 5 to 10 km. This is not sufficient to account for the sharp cessation of the solar spectrum at about 2800, and therefore the result is in keeping with the fact that the ultraviolet limit of the solar spectrum is due to effects of the high atmosphere. (*Authors' abstract.*)

H. E. MERWIN, *Recording Secretary.*

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ARCHAEOLOGY.—*On the recent discovery of a flint arrow-head in early Pleistocene deposits at Frederick, Oklahoma.*[1] OLIVER P. HAY, Washington, D. C.

A recent article by Dr. Charles N. Gould,[2] state geologist of Oklahoma, records the discovery of a flint arrow-head in Pleistocene deposits in a sand pit worked by Mr. A. H. Holloman, near Frederick, in southwestern Oklahoma. For those not familiar with the locality and the circumstances I will briefly describe them.

Immediately north of Frederick is the south end of a ridge averaging about one half mile in width, rising about one hundred feet above the surrounding country. The ridge extends from eight to ten miles north and gradually subsides in height. It is composed mostly of sand, fine and coarse, and gravel, including some stones of diameters up to five inches. The bottom consists of a few feet of gravel cemented into a moderately hard rock. The sand and gravel are distinctly cross-bedded and were evidently laid down by a stream that brought them long ago from probably the Wichita Mountains, twenty miles to the north. The deposit rests on the Permian red clay which covers a large portion of this part of the State. After a time the stream became choked by its deposit and sought a channel elsewhere. Still later the Permian on each side was eroded away at least one hundred feet and the old forsaken river bed became a ridge.

For some years Mr. Holloman has been exploiting this ridge to supply customers with sand, gravel and clay for buildings and roadbeds and has removed two or three acres of the materials. In doing so he has at various times discovered the bones and teeth of twenty-five or

[1] Received February 2, 1929.

[2] This JOURN. **19**: 68. 1929.

more species of extinct animals. About two years ago he found, as he affirms, embedded in the cemented gravel, at a depth of about twenty-five feet, a flint arrow-head. Later, at a somewhat higher level, he discovered what is probably a flint drill; also some grinding stones, or metates. Accounts of these have been published, but doubts have been entertained as to the antiquity of the objects.

About the middle of September, 1928, Mr. Holloman observed another arrow-head in the cemented gravel at a depth of thirteen feet and near the Permian floor. Work was stopped at once at that point and Mr. A. N. Krause, a photographer, was called. He had long been a friend of Dr. Gould and had been requested by him to photograph in its original position any special object that should be found. He took pictures of the arrow-head before removing it and these were sent to Dr. Gould, at Norman. Within a few days he and Dr. Leslie Spier and others of the University of Oklahoma went to Frederick. The face of the pit where the arrow-head had been buried had meanwhile not been disturbed. The arrow-head was put in its former position on the rock and other photographs were taken. Unfortunately the photographs are nearly all very small and are not adapted for reproduction. One taken of the arrow-head after removal shows the object to be 56 mm. long and 38 mm. wide. It is said by Dr. Spier to be a nicely chipped artifact.

Dr. Gould's report on the case has been published, as cited. Dr. Spier has written a statement for me and kindly permits me to quote it. It follows:

> There can be no doubt that the artifacts occur in the pit near the basal portion, on the same level as the fossil remains. An examination of the undisturbed face of the pit, immediately above the position of the finds, showed unbroken, nearly horizontal strata above it. There is no evidence of gullying at this point, whatever may have been the case with respect to the other finds. As the case stands, it looks very much as though the artifacts are of the same antiquity as the fossil animals. At the same time it would be well to reserve final judgment until we are certain that the artifacts are not secondary inclusions. It must be borne in mind that the artifacts are of a distinctly modern type and their occurrence with an early Pleistocene fauna is incongruous when considered in the light of Old World finds.

This new discovery, attested as it is by two scientific men, one a geologist, the other an anthropologist, corroborates Mr. Holloman's statements regarding the finding of the objects about two years ago.

Invariably, when Pleistocene artifacts have been reported, the objection has been raised that no scientific man has been a witness to

the occurrence. This objection can hardly be made in the present case.

But Dr. Gould and Dr. Spier are not the only scientific men who have participated in such discoveries. In 1874 another scientific man reported[3] that he had two years before writing taken out of the loess with his own hands, in a railroad cut, two and a half miles southeast of Omaha, at a depth of twenty feet, a large flint arrow-head. This was buried thirteen inches below and a little to one side of the lumbar vertebra of an elephant. At another time, about 1869, he had found a small arrow-head in the loess near Sioux City, Iowa. This man was Professor Samuel Aughey, of the University of Nebraska, geologist and zoologist.

Another man of science, Dr. W J McGee, geologist and anthropologist, has given his testimony. Riding along Walker River, Nevada, in 1882, he observed an obsidian arrow-head in a nearly horizontal position with its point sticking out of the lake silt, twenty-five feet below the surface. Sitting down he pondered half an hour how the arrow-head had reached that position, but all his hypotheses were dissipated when with his knife he cut away the silt in which it was embedded. He was wholly unable to explain the case. From that same deposit he had on that day collected remains of elephant, horse, bison and camel.

About 1916 Dr. E. H. Sellards, then state geologist of Florida, assured the public that he had found artifacts and remains of skeletons of human beings associated with bones of extinct Pleistocene mammals at Vero, Florida. The anthropologists and geologists who at his invitation visited the locality marshaled an array of arguments to show that he was mistaken. More recently Dr. Gidley, at New Smyrna, and Dr. Loomis and Dr. Gidley at Melbourne explored deposits of the same age and in every way confirmed and extended Dr. Sellards' discoveries.

For several decades the public had been assured that the argillite artifacts found in the yellow loam at Trenton, New Jersey, three or four feet thick, had reached their places accidentally and were relics of Indians of no great antiquity. Eminent geologists and anthropologists affirmed that the loam was probably composed of wind-blown sand and dust laid down after Delaware River had cut its deep channel and that the stones in it had been carried there by the makers of the artifacts; or that the deposit had been laid down during a marine sub-

[3] U. S. Geol. Geogr. Surv. Terr. Ann. Rept. 1874: 254. *ill.*

mergence; that, whatever its origin, it had been completely worked over by burrowing mammals, insects and worms, by the penetration of roots and by the overturning of trees. The artifacts were asserted to have made their way down by means of burrows and rootholes. In short, there was no certainty of anything, except the non-antiquity of the artifacts.

Using a new method of research Dr. Leslie Spier demonstrated that the artifacts and the pebbles had a definite and orderly arrangement and had been deposited by the same agency and at the same time, and that the argillite artifacts were not those of the modern Indians. Dr. Spier's investigations indicate clearly that the clay, sand, stones and artifacts were brought there from a not distant point by water escaping from the front of the Wisconsin glacier, and this conclusion has been accepted by Dr. Clark Wissler.[4] With this exception, I can not learn that any anthropologist or any geologist has ever mentioned in print Dr. Spier's remarkable paper.

These are only a few of the contributions made by scientific men to the history of early man in America. If now the honesty of such men or their ability to discriminate is called into doubt they are in such matters put on a level with men who are untrained.

Besides these geologists and anthropologists there have been many men who have made no claim to scientific training, but who were observant and, so far as we know, honest, and who reported what they saw and handled. Some of these may have been mistaken, but their concordant testimony can not easily be ignored.

Whenever evidences of Pleistocene man have been reported most anthropologists have been ready to explain the occurrences as the result of the action of natural agencies within recent times. I need not to repeat a catalogue of these agencies. They are possible sources of error, but rarely or never have those proposing such explanations been able to show that the agency proposed really acted in that particular case, and I know of no one who has done more to show the futility of these theories than Dr. Leslie Spier.

It was therefore somewhat surprising, on reading Dr. Spier's communications in *Science* (February 10 and August 24, 1928), to find him coming forward to propose the same explanations that he had so completely discredited by his work at Trenton. As a result of his recent investigations at Frederick, he is now ready to withdraw or to qualify most of these.

[4] Sci. Month. **2**: 234. 1916.

What now are the results secured and what are the conclusions that we must reach? I shall begin with the Trenton case, the one which furnishes evidences of probably late Pleistocene man.

While the Wisconsin glacier lay across the Delaware at Belvidere a tremendous frontage sent its flood down the river past Trenton. When the ice had retired to about latitude 42° 30′ the frontage was reduced to a very few miles. It was probably about this time that the river had cut its deep channel and had finished laying down the bed of loam. A little later all the glacial discharge of the region north of Trenton was diverted into the Hudson and the Susquehanna rivers. This may have occurred, we must believe, from twelve to twenty thousand years ago, but this was long before the close of the Wisconsin glacial stage. How are our anthropologists going to explain the presence of the argillite people at Trenton at that time?

From the loess along Mississippi River artifacts have been reported from four localities. (a) Near St. Louis, as reported by Dr. C. A. Peterson, a stone ax was unearthed at the bottom of the loess. (b) Near Alton, Illinois, an ax was found by John Ford, who presented it, together with 15 species of loess shells and some bones of a wolf, to the Academy of Natural Sciences, Philadelphia. (c) A stone ax was reported by a Mr. McAdams as obtained from a well in Greene County, Illinois. (d) At Muscatine, Iowa, flint arrow-heads and spalls were stated by Professor F. M. Witter to have been collected by himself and friends.

From the loess at four localities along Missouri River artifacts have been asserted as discovered. (a) At St. Joseph, Missouri, an ax was stated by Luella Owen to have been found in the loess. (b) From Council Bluffs, Iowa, Dr. J. A. Udden reported an ax as discovered in loess at a depth of thirty feet. (c) Professor Aughey's find of an arrow-head at Omaha has already been mentioned, and (d) also the arrow-head found by him at Sioux City, Iowa. The deposition of the loess preceded in all probability the Wisconsin glacial stage, possibly long antedated it.

All of these discoveries in the loess, except that of John Ford, are discussed in the author's paper[5] published in 1918. John Ford's report is to be found in the Proceedings of the Philadelphia Academy, 1877, page 305.

If these eight finds are characterized as frauds or mistakes how does it happen that no such reports come to us from the glacial drifts which

[5] Am. Anthr. **20** (1).

occur in the same region? If the loess slumps, as it is said to do, so also does the glacial drift.

Somewhat older than these evidences of Pleistocene man is the human innominate bone reported by Dr. M. W. Dickeson as found in a deposit underlying the loess at Natchez, Mississippi, associated with bones of *Mylodon* and *Megalonyx.* Naturally the human bone was explained as having fallen down from an Indian grave into the deep gully. This explanation has been shown to be incorrect. Chemical analyses made by Dr. F. W. Clarke proved that a bone of the mylodon contained less than four per cent of silica; that of the man, over twenty-two per cent.

Mention has been made of the fossils found by Dr. McGee along Walker River. Within a very few years past a party sent out by the U. S. Geological Survey discovered bones and teeth of a bison, of a horse, and of a large camel in the same locality.

The artifacts and human bones found in Florida by Sellards, Loomis, and Gidley were mingled with bones and teeth of many vertebrate animals which lived, so far as is known, only during the first interglacial stage. Because, however, this is a low-lying region the deposits have been and are yet by some regarded as late Pleistocene. The animals found there show this to be an erroneous conclusion.

At Frederick, Oklahoma, we find a different geological situation. Here occur remains of about twenty-five species of fossil vertebrates all of which, except man and a soft-shelled turtle, are extinct. Besides this, there has been required time for a river to fill up its bed twenty-five feet deep and to go elsewhere, and time for the whole region to become eroded away one hundred feet, and perhaps considerably more. The paleontology and the geology point certainly to early Pleistocene.

Anthropologists may have difficulty in making the history of man on this continent harmonize with that of the Old World, but it will not be accomplished by attributing to human bones and artifacts in regions where Pleistocene man might have lived greater likelihood of getting down deep into the earth than they have where man could not have lived.

Our anthropologists have still more difficulty in accepting the view that early Pleistocene men were able to produce flint weapons as skillfully chipped as those found in late Pleistocene in Europe. They ought to recognize the possibility that in eastern Asia there developed an earlier and more advanced technique and that this made its way into America far sooner than into Europe.

PALEOBOTANY.—*A fossil* Meliosma *from the Miocene of California.*[1]
EDWARD W. BERRY, Johns Hopkins University.

The specimen upon which the present note is based was sent to me some years ago and was collected from the lower Miocene, $2\frac{1}{2}$ miles south of San Juan, California. Recently, in connection with the study of a large series of fossil fruits from South America, I have had the opportunity of comparing this California fruit with recent material, with the result that it appears to represent the genus *Meliosma* Blume of the family Sabiaceae.

This genus comprises about 50 existing species, mostly tropical and subtropical, and largely developed in the southeastern Asiatic region, but with a number of species in the New World in the region between the Antilles, Mexico and northern Brazil. Certain shrubby species, cultivated for their showy flowers, are hardy in southern England and as far north as about the latitude of New York in this country, but the majority are not.

The fossil, which may be called **Meliosma californica** n. sp., has the appearance of a nut from which the shell has been corroded, and is not unlike a tiny hickory or walnut under similar conditions of preservation, except that the cotyledonary lobes are full and smooth and not corrugated in the parts that are visible. In the recent species of *Meliosma* the fruit is a thin-fleshed drupe with a somewhat corrugated crustaceous stone, and the fossil may be considered to represent the stone of a similar drupe.

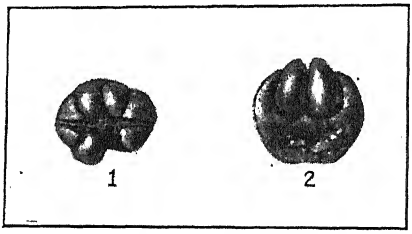
As reduced in size by corrosion it is between 11 and 12 millimeters high, 13 millimeters in maximum and 11 millimeters in minimum diameter. It was presumably two celled, since there is a median septum which appears to have been complete, as shown in Figure 1. On either side of this septum four conical processes are seen, the two central ones coming out from inside the outer ones. The latter are more pointed than the central ones, do not extend upward so far and are more incurved and at right angles to them; they all merge below in common tissue, the whole forming a sublunate bounding mass from which the central processes appear to emerge.

The correct interpretation of the observed features is somewhat obscured and the single specimen cannot be destroyed in seeking an answer to the hidden relations of the processes seen. Obviously they represent the curved lobes of the lobate cotyledons and the similarly curved radicle of the embryo. Whether the fossil should be considered

[1] Received January 28, 1929.

to represent the embryos of two seeds, or the more lobate embryo of a single seed I have not been able to decide.

In the recent species that I have seen, the stones range from one-half to two or three times the size of the fossil. In the common Mexican species, *Meliosma dentata* Urban, they are about three-fourths the size of the fossil. In *Meliosma herberti* Rolfe of the Antilles they are about the same size. The ovary of these is usually two celled, but occasionally three celled, with two ovules in each cell, of which but one usually matures; the seed coat is thin to membranous; the cotyledons are lobed and curved, as is also the radicle; endosperm is normally wanting or very thin; and usually but a single seed matures.



Figures 1 and 2. *Meliosma californica* Berry, n. sp. 1. End view, natural size. 2. Side view, slightly enlarged.

I regard the identification of the fossil as reasonably certain, and it indicates a wider geographical range of the genus in the Western Hemisphere than prevails at the present time, and a late Tertiary restriction of range which may legitimately be attributed to climatic changes. A similar conclusion is also indicated for the Eastern Hemisphere by a Pliocene species described from Holland by the Reids.[2]

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE PHILOSOPHICAL SOCIETY

981st MEETING

The 981st meeting was held at the Cosmos Club, November 24, 1928.

Program: C. R. Randall: *A method for detecting dissymmetry in the prongs of a tuning fork.* The frequency of a freely vibrating tuning fork varies in general with the kind of mounting. In the present investigation a number of low frequency (about 70 vibrations per second) forks were worked with.

[2] C. & E. M. Reid. *The Pliocene floras of the Dutch-Prussian border*, p. 113, *pl. 11, figs. 19–21.* 1915.

It was found:

(1) That any dissymmetry present in the two prongs of the fork may be seen readily by the eye if the fork is clamped tightly in a horizontal position on a heavy rectangular base (about fifty times the weight of the fork) and if the base is placed on sponge rubber blocks so that it is free to move.

(2) For a dissymmetrical fork it may be found by the naked eye that there is a particular position of the fork clamp on base where the two prongs will each have a frequency of their own, perhaps differing from each other by as much as 2 per cent for half-second intervals.

(3) This dissymmetry of the two prongs may be corrected to within 0.1 per cent, say, by direct observation by placing a proper load at the end of the proper prong.

(4) If now the base is given a firm support the slight difference in frequency will disappear and the common frequency of the two prongs will lie somewhere between.

(5) It is probable that a fork once permanently corrected for dissymmetry will have a free vibration frequency for $\frac{1}{2}$ second intervals constant to within 0.03 per cent, provided: (a) the fork is given a reasonably rigid, firm, massive mounting, and (b) the temperature and amplitude are practically constant. (*Author's abstract.*)

C. Moon: *A precision method of rating a tuning fork.*

L. B. Tuckerman: *Making a high-grade reticule.* The optical lever system consisting of an autocollimator and a quadruple mirror system devised by me several years ago is being increasingly used in strain gages for the measurement of small deformations. Each instrument so far constructed has had its own calibration constant, differing in some cases by as much as two to three per cent from one.

Where thousands of readings are taken, the multiplication of each by some factor as 0.973 is time-consuming and adds materially to the cost of the measurements. For this reason it was decided to attempt to produce standard autocollimators and strain gages which should have a calibration factor of 1.000 within the tolerance of $\pm$ 1/10 per cent. This required a standard lever arm on the strain gage lozenge, autocollimator objectives of standard focal length, and standard reticules, all accurate within $\pm$ 1/10 per cent. Stellite lozenges with a lever arm $=0.2000 \pm 0.0001$ in. have been made by the Gage Section of the Bureau of Standards. Objective lenses specially corrected for spherical aberration and coma and adjustable in focal length to 25 cm. within 1/20 per cent have been designed by Dr. Gardner and constructed by the Optical Instrument Shop of this Bureau.

The construction of photographic reticules of the desired accuracy proved difficult. After trying many methods, reticules were finally produced which have no error greater than 1/10 per cent within the limits of their normal use. These were produced in the following manner. The bed of a Geneva Society ruling engine was mounted on a milling machine and with a specially ground milling cutter properly spaced cuts were made in a copper engraving plate. Prints from this plate were made on special map paper. Engraved lettering and numbering was mounted in the proper places and the outline of the reticule patterns carefully drawn in. A one-half size photographic reduction of these diagrams was then made, the superfluous lines blocked out on the negative and a zinc etching made. Prints from these etchings (50 cm. in diameter) were sent to Rheinberg and Company in England who produced from them glass reticules 2 cm. in diameter by their method of "grainless photography." The accuracy of the reproduction was controlled at every

step of the process by measurements made by Dr. Judson of the Length Section of the Bureau of Standards.

The zinc etchings showed no errors greater than 1/20 per cent and the errors of the finished reticules exceed 1/10 per cent only near the ends of the scale.

The production of these reticules was only possible through the coöperation of many people. Especial credit is due to Mr. J. H. Larrabee and his assistants of the Map Division of the Hydrographic Office of the Navy Department. The precision photographing, etching and printing done by them was an essential part of the making of the reticules. (*Author's abstract.*)

982D MEETING

The 982d meeting, constituting the 58th annual meeting, was held at the Cosmos Club December 8, 1928.

The officers elected for the ensuing year are as follows: *President,* L. H. ADAMS; *Vice Presidents,* W. D. LAMBERT and F. E. WRIGHT; *Treasurer,* O. H. GISH; *Recording Secretary,* O. S. ADAMS; *Members-at-large of the General Committee,* E. O. HULBURT and F. WENNER.

Program: H. N. EATON: *Model experiments applied to river regulation.* There is great interest at the present time in flood control on our rivers owing to the recent disaster along the Mississippi and the resultant plans for the construction of comprehensive regulation works designed to minimize damage from the recurrence of high water. In Europe the use of model experiments as a guide in planning river and harbor regulation has become almost universal, as is made evident in a recent book, "*Hydraulic Laboratory Practice.*" This method has not been developed to any great extent in this country, partly owing to a lack of appreciation of what has been accomplished abroad.

The first application of model experiments to a practical river problem was made by Fargue in France when he studied by means of a model with a sand bed the effect of the proposed regulation of the Garonne river. He found that in this instance regulation works must supplement dredging in order to produce effective results. He did not pay much attention to conditions of similarity between his model and its prototype in nature, yet was able to obtain valuable information from his tests.

Tests of this kind were first placed on a scientific basis by Osborne-Reynolds in England in his work with models of the Mersey Estuary. Further work was done by Vernon-Harcourt· Professor Engels at Dresden commenced work about the first of this century with river models, and this work has been expanded continually until there are now about a score of river laboratories in Europe working actively on this and related problems.

One of the most interesting and scientific investigations of this nature has been made at the Versuchsanstalt für Wasserbau and Schiffbau in Berlin in connection with the low water regulation of the Elbe river. The report on this investigation illustrates clearly the processes involved in computing various transference scales connecting quantities in the model with those in nature. This is difficult when there is movement of sediment in the model, particularly as regards the scales of depth, slopes, time and quantity of sediment moved. The method of computing these scales is given in detail in their report, together with a discussion of the results obtained by trying various arrangements of regulating works in the model river.

One interesting feature was the discovery of waves of sand which moved slowly down the river, as was determined by taking successive longitudinal

profiles of the river bed. Other interesting results were obtained from a study of the prevention of scour around the ground sills. The customary formation of a bar at the crossovers was prevented by a slight constriction of the river banks. (*Author's abstract.*)

H. E. MERWIN, *Recording Secretary*

THE BIOLOGICAL SOCIETY

723RD MEETING

The 723rd meeting was held at the Cosmos Club October 20, 1928, at 8:10 p. m., with Vice-President WETMORE in the chair and 70 persons present.

A resolution presented by Dr. L. O. HOWARD commending the services to science of Dr. CARLOS E. PORTER of Santiago, Chile, was read by the Secretary and discussed by Dr. W. L. SCHMITT. On proper motion it was voted that the resolution be approved by the Society and a copy transmitted to Dr. Porter. The resolution follows:

Whereas, Dr. CARLOS E. PORTER founded, thirty-two years ago, the valuable scientific periodical known as the *Revista Chilena* and has continued it through all the years since, practically single-handed and unaided, with very great expenditure of valuable time and very considerable personal financial loss;

And Whereas, he has, through this journal, made possible the prompt publication of the results of the work of recognized South American scientific men and of those endeavoring to achieve recognition by the publication of the results of their studies in the field of science;

And Whereas, he has built up an extremely valuable and noteworthy zoological library, particularly in the fields of entomology, carcinology and economic zoology, the best of its kind in his own country, and in doing so has rendered inestimable service to science, not only in Chile but also in other countries in South America;

And Whereas, he has fostered science and encouraged other workers to the utmost of his ability, not only personally but through his teachings and lectures;

Therefore Be It Resolved, That the Biological Society of Washington extends to CARLOS E. PORTER its hearty commendation and recognition for the great service he has rendered his native land and science in general in the furtherance and perpetuation of scientific research and endeavor.

T. E. SNYDER, one of the delegates from the Society to the Fourth Entomological Congress held at Ithaca in 1928, made a report.

C. W. STILES exhibited drawings of a nematode (*Gongylonema* sp.) which is only rarely found in man. The present infestation, which occurred in a patient in Richmond, Virginia, is only the fifth American case reported since 1917. The infestation was evidently caused by eating a cockroach or beetle. A species of *Gongylonema* is associated with cancer in rats but certainly not in man.

HOWARD BALL reported the observation of several Golden Plover, one of which was taken, in the vicinity of Washington this autumn.

F. C. LINCOLN reported the recent capture of three specimens of Forster Tern in the vicinity of Washington, from a flock of perhaps twenty. He also noted the taking of a nest and eggs of Prothonotary Warbler in the vicinity of Washington last June, the first definite local record of breeding for this species.

A. WETMORE reported the taking of two specimens of Boat-tailed Grackle near Ocean City, Maryland, on October 6, 1928, out of a flock of about a dozen.

Program: ARTHUR H. HOWELL: *Animal life in a North Carolina forest.*—The speaker outlined studies made in the Bent Creek area of the Pisgah National Forest, N. C., during April and May, 1928, under cooperative arrangement between the Forest Service and the Biological Survey.

Efforts were directed chiefly to ascertaining the mammal and bird population on several two-acre tracts in typical portions of the forest. An average of 50 small traps was operated on each area for periods of 14 days each; on an oak-chestnut area on steep north slope, 12 rodents, 4 shrews, and 1 bat were recorded; on an oak-pine area, 7 rodents and 1 shrew; on an area of the cove-hardwood type, 24 rodents and 6 shrews. The rodents comprised 3 species of *Peromyscus*, *Napaeozapus insignis*, *Sciurus carolinensis*, *Glaucomys volans*, and *Sylvilagus floridanus;* the shrews were *Blarina brevicauda*, *Sorex* (2 species), and *Microsorex hoyi*. The stomachs of all mammals caught were saved for future examination of the food contents. Twenty-two species of birds were recorded on the areas studied. (*Author's abstract.*)

ALEXANDER WETMORE: *Zoological exploration in Hispaniola.*—The island that Columbus named Hispaniola, divided politically between the Dominican Republic and the Republic of Haiti, offers one of the most interesting areas for zoological study in the West Indies, since it has the largest area of land above 3000 feet altitude to be found in the Greater Antilles. Early collectors in Cuba, Jamaica, and Porto Rico found a coastal plain fauna, and an inland fauna was encountered in the hills that did not change appreciably in character in the limited areas of higher altitudes. When these same two associations of animals were found in the island of Hispaniola, it was assumed that the same conditions held in higher altitudes as in the other islands mentioned, and it was not until 1916 that through exploration by Dr. W. L. Abbott, it was found there were peculiar forms in the island above 4000 feet that did not come to lower elevations.

The speaker outlined a collecting trip made for the Smithsonian Institution under the Swales Fund from March 27 to June 3, 1927, during which he covered a considerable part of Haiti and the Dominican Republic. Work began at Port-au-Prince, continued to Fonds-des-Négres, and included a visit to the Massif de la Selle where collections were made at over 7000 feet altitude. Following the central plain near Hinche and later the northern plain at Poste Chabert were visited.

In the Dominican Republic investigations began with a traverse from the border at Comendador to Santo Domingo City, and then to San Francisco de Macoris and Sánchez. From the latter point as a base, journeys were made to various sections of Sanana Bay. Continuing inland to La Vega a journey was made to the high valley of Constanza, and then returning again to the lowlands investigations were completed at Puerto Plata.

The work included was supplementary to some degree of the prolonged investigations of the veteran traveler Dr. W. L. Abbott on whose collections a series of reports are now in preparation. (*Author's abstract.*)

Discussed by W. SCHAUS, P. BARTSCH, T. S. PALMER, and L. STEJNEGER.

724TH MEETING

The 724th meeting, a joint meeting with the Philosophical Society of Washington and the Optical Society of America, was held at the Cosmos Club November 3, 1928, at 8.15 p.m., with Vice-President WETMORE in the chair and 170 persons present. New members elected: MARY E. HAYNES, R. W. JONES, G. S. MYERS, and A. S. RIPPEY.

Program: SELIG HECHT, Columbia University: *The nature of the sensitivity of animals to light.*—Most light sensitive animals possess in common certain familiar properties. The capacity for light adaptation; the capacity for dark adaptation; an intensity threshold; a light and dark period in the duration of stimulus reception; and the ability to discriminate differences in intensity. From these similarities one may suppose that the organization of the photosensitive system which determines photoreception is fundamentally similar. A hypothesis has therefore been proposed in which a qualitative and quantitative representation is made of these and many other characteristics of photoreception. This system is a coupled photochemical reaction, and consists of two parts: first, a reversible photochemical reaction proper; and second, an ordinary chemical reaction which is catalyzed by the photolytic products of the first reaction. A definite amount of material is required to be formed in the secondary reaction in order to discharge the sense cell and to start an impulse in the attached nerve.

When intensity discrimination is studied in terms of this system it is found that for an animal to distinguish between one intensity and the next perceptibly different one, there is necessary a constant increment in the amount of photosensitive material decomposed in the sense cell. It is possible to describe this as an increase in frequency of discharge to the attached nerve, or as an increase in the number of sense cells functional in a given area. The former makes it difficult to understand the discontinuity of intensity discrimination, whereas the latter involves the existence of a statistical distribution of thresholds among the sensory cells. Independent evidence from the relation between visual acuity and illumination shows that there is in reality such a statistical distribution of thresholds, the nature of which corresponds to the demands of intensity discrimination. It is therefore assumed that intensity perception is a function of the number of related receptor elements which are functional in a given area. It is, however, true that intensity discrimination, though discontinuous, possesses no critical points. And moreover, frequency of discharge in a given cell is an experimentally demonstrable function of intensity. It is therefore concluded that to discriminate one intensity from the next perceptibly different one, there must be produced in a group of related sense cells a constant increase in frequency of discharge, which is the result of the addition of one more functional element to those already functional. (*Author's abstract.*)

S. F. BLAKE, *Recording Secretary.*

725TH MEETING

The 725th meeting was held at the Cosmos Club November 17, 1928, at 8.10 p.m. with President GOLDMAN in the chair and 175 persons present.

Program: M. W. STIRLING: *By airplane to Pigmy Land.*—During the year 1926, Mr. STIRLING conducted a cooperative expedition into Netherlands New Guinea under the combined auspices of the Smithsonian Institution and the Indian Committee for Scientific Research, of Batavia, Java. New Guinea, the second largest island of the world, is today the least known of any section of equal size on the habitable globe. Exploration is fraught with many difficulties as a result of the rugged nature of the terrain which must be traversed, hostile peoples who are encountered, and an unhealthy climate.

The objective of the expedition was the central portion of the Nassau Mountains lying to the north of the Carstenz Top, where a large group of Negritos was discovered and ethnological studies made of them. Several

tribes of Papuans encountered along the transport line on the Mamberamo and Rouffaer Rivers were briefly studied en route.

The total personnel of the expedition was more than four hundred, consisting of Dyaks, Malay convicts, and native Ambonese soldiers, in addition to the Europeans and Americans. An interesting feature of the expedition was the use of an airplane for reconnaissance purposes and for freighting supplies. The large ethnological collection brought back to America is now in the U. S. National Museum. (*Author's abstract.*)

W. B. Bell, *Recording Secretary pro tem.*

726TH MEETING

The 726th meeting was held at the Cosmos Club December 1, 1928, at 8.10 p.m., with Vice-President Wetmore in the chair and 80 persons present.

C. W. Stiles discussed certain questions of nomenclature.

T. S. Palmer gave an account of the recent meeting of the American Ornithologists' Union at Charleston, South Carolina.

Howard Ball mentioned some of the interesting birds seen at Charleston.

Frank Thone presented for examination several recent books on biology.

Program: E. R. Kalmbach: *Notes on Washington starlings.*—After a brief discussion of the introduction of the starling into the United States and its subsequent spread throughout the East and neighboring Provinces of Canada, the speaker presented his observations on the starling roosts of Washington. Both tree roosts and building roosts were discussed and mannerisms of the gathering birds described. Mention also was made of their winter food habits and data presented on their seasonal migration gained from returns of banded birds. The talk was illustrated with slides depicting outstanding features of Washington starling roosts. (*Author's abstract.*)

A. S. Hitchcock: *Collecting grasses in Newfoundland and Labrador.*—During July and August, 1928, the speaker visited Newfoundland to study and collect grasses. He made collections at Port-aux-Basques, St. Georges, Corner Brook, Little Harbor, Grand Falls, and St. Johns. Newfoundland is, in a general way, triangular, measuring nearly 400 miles on a side. The coast is mostly rocky and precipitous with many bays and inlets. The interior is fairly level or rolling, with many lakes and marshes. There are low mountains rising to 1500 or 2000 feet but no distinct ranges except in the narrow peninsula at the northwest. A narrow-gauge railroad runs from Port-aux-Basques, at the southwest corner, north through St. Georges to Corner Brook, then eastward through Grand Falls, and finally south and southeast to St. Johns, the capital. There is a fine closed harbor at St. Johns to which come many steamship lines. Most of the inhabitants are living in the southeast corner of the island. Many small towns and fishing villages are scattered along the entire coast. The interior except in the vicinity of the railroad is practically uninhabited. The basic industry in Newfoundland is its fisheries. There are a few mines of iron and copper, some agriculture, and two large paper mills. The forests of Newfoundland are not of prime importance for the production of lumber but they will furnish an almost unlimited supply of logs for paper pulp.

The grass flora of the island is rather meager. Much of the island is glaciated and because of its isolation many species failed to return following the glacial period. The dominant species of grasses are *Agrostis stolonifera*, *A. maritima*, *A. capillaris*, *Calamagrostis canadensis*, *Deschampsia flexuosa*, *Festuca rubra*, and *Poa palustris*. Sandy shores are not common but where

they occur one may find *Ammophila breviligulata* and *Elymus mollis*. In marshes and wet places are *Glyceria striata, G. canadensis, Deschampsia caespitosa,* and *Calamagrostis inexpansa*. On bare hills and cliffs are *Festuca ovina, Agrostis borealis,* and *A. hiemalis*. A short trip was made to Labrador, with five days' stop at Cartwright, and a short stop at Battle Harbor. (*Author's abstract.*)

Discussed by DAVID FAIRCHILD.

727TH MEETING

The 727th meeting was held at the Cosmos Club December 15, 1928, at 8.10 p.m., with Vice-President STILES in the chair and 40 persons present.

New members elected: E. B. BARTRAM, J. E. BENEDICT, JR., H. C. CONOVER, M. B. DRISCOLL, G. A. SCHULZE, MARY S. SKINNER, and C. E. UNDERDOWN.

E. A. GOLDMAN was nominated as Vice-President of the Washington Academy of Sciences to represent the Biological Society.

H. C. OBERHOLSER reported that there are more ducks on the Potomac River this year than for many years past, and almost twice as many as last year. About three-fourths are canvasbacks. The hunting blinds along the river are not decreasing the number of ducks.

F. C. LINCOLN gave an account of a robin which had been domesticated by a lady in Cincinnati. It was brought her when very young, raised, and finally turned loose. It insisted on flying into the house every evening and remained throughout the winter and until the spring, when it disappeared. Some time after, when she was standing in front of a cage of small birds in the Cincinnati Zoo, this robin, which she recognized by its behavior and by a blue band which she had placed on its foot, flew against the wire and gave every symptom of recognizing her. She is now trying to get a permit to keep the bird.

FRANK THONE exhibited the fifth volume of the new and complete edition of Pasteur's works. In reply to a question by Dr. STILES, he stated that all books of permanent value received by Science Service are preserved and catalogued and are accessible to persons interested.

Program: C. E. RACHFORD: *Game administration in national forests.*—The speaker discussed the problems of wild life administration on the 159 national forests, which contain over 158,000,000 acres, the related uses of timber, grazing, watershed protection, recreation, etc. In a description of these areas it was pointed out that some of them are adaptable to game use; others are now supporting a small remnant of once large herds of big game animals; some are on the road to a fairly well stocked condition; while on others the problem is that of too many animals for the feed available. In approaching a solution of the problem he outlined three broad questions, as follows: 1, How can we get more game on many areas? 2, How can we get less game on some areas? 3, How can we maintain the right number of game animals on any given area? Successful game administration depends upon the correct answer to these problems. In answer to these questions he pointed out the need for research on wild life subjects. (*Author's abstract.*)

Discussed by T. S. PALMER and E. P. WALKER.

F. C. BISHOPP: *The warble fly and its fifty million dollar tune.*—The cattle grubs or warbles constitute a problem of great importance to many individuals, the annual loss caused by them being estimated at fifty million dollars. The dairymen, live stock producers, feeders, packers, hide dealers, tanners and

leather manufacturers, as well as the ultimate consumers of beef and leather each sustain a portion of this loss. The various ways in which the cattle grubs produce these losses and the interrelations between various hosts and these parasites was discussed. The intricate life cycle of the two species concerned (*Hypoderma bovis* and *H. lineatum*), was explained and other interesting facts in the biologies of the flies were discussed. Several methods of control were outlined and their relative merit was commented upon. The flies do not sting the cattle when the eggs are laid and there is no satisfactory explanation of the fear among animals produced by them.There are also many interesting facts regarding distribution and abundance which need elucidation. For instance, no logical explanation has been presented of the complete absence of this pest from the Red River Valley of the North. (*Author's abstract.*)

Discussed by L. O. Howard and C. W. Stiles.

S. F. Blake, *Recording Secretary.*

SCIENTIFIC NOTES AND NEWS

A series of meetings dealing with the general subject of the corrosion of metals which promises to be of unusual interest has been arranged under the joint auspices of the Washington Sections of the American Chemical Society, the American Institute of Mining Engineers and the American Society for Steel Treating, on Thursday and Friday, March 14 and 15. Three lectures will be given by Ulick R. Evans, of Cambridge University, England, an outstanding British authority on the subject, who will speak on the following subjects: *The passivity of metals—the study of thin oxide films, The rusting of iron*, and *The general principles of corrosion and protection of metals.* The first and third of the series will be given on the evenings of March 14 and 15 in the Auditorium of the Interior Department, and the second lecture on the afternoon of March 15 at the Bureau of Standards. Following the afternoon meeting will be a Speaker's dinner at the Cosmos Club in which the three societies will participate. The series will cover both the theoretical aspect as well as the more practical side of the subject of corrosion, and each lecture is complete in itself.

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GEOPHYSICS.—*Deformation and temperature.*[1] P. G. NUTTING, U. S. Geological Survey.

A steel tape is cooled by stretching, rubber is warmed. In either case the thermal effect is sensibly proportional to the elongation and is many times as great as the external work causing it. We say that the tape is cooled because intermolecular forces are weakened by the stretching although the strain is far within the elastic limit and strictly reversible. Similarly rubber is heated because the stretch pulls chains of molecules into line thus increasing internal potential. But to permit a balance of the energy equation, each of the above arguments must be reversed. All the energy change is not taken into account.

When water vapor, saturated at 25°, is liquefied by compression, the external work required is equivalent to 32.8 calories per gram of water condensed. But the condensed water immediately does 17 times as much work on itself, releasing 549.5 calories per gram. The large gain in internal kinetic energy which this represents of course comes neither from the external work nor from released internal potential but from the great increase in both pressure and concentration incident to the change in state.

These instances go to indicate the dominant part played by molecular physics in the heat changes due to deformation. It is proposed here to present and analyze some of the best data available, drawing such deductions from thermodynamical reasoning as seem admissible and pertinent to geological problems.

[1] This material was prepared in connection with a discussion of the internal pressures in adsorbed films, but since it is of geological rather than chemical interest, it is here published separately.

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When a gas is compressed, the heat generated is precisely equal to the work done in compression. If allowed to expand, doing work, it is cooled, otherwise it is not. In any case, the heat lost is equal to the work done in expansion. When water is stirred, the thermal energy generated is exactly equal to the work of stirring (Rowland's experiment). Our established value of the mechanical equivalent of heat (4.18×10^7 ergs/calorie) was thus determined. In these instances powerful intermolecular forces (internal pressures) were not called into play—in gases they do not exist; in the stirred water they ended as they began. Even in Rumford's experiment of measuring the heat developed by boring a cannon with a dull tool, he was in error apparently only by the energy represented by the permanent strain in the chips. But for this energy of internal strain, the thermoelastic and thermoplastic problems would be very simple, heat developed would equal work done and if either were known the other could be easily computed. But the internal work in compressed liquids and in compressed and deformed solids is usually many times as large as the work done, is positive for some substances and strains, negative for others, and varies with both temperature and pressure.

The general theory of heating by compression (applicable to liquids and gases) was developed by W. Thomson (Lord Kelvin) about 1850, apparently as a result of a controversy with Clausius over the latter's use of Carnot's function, and in collaboration with Joule on the determination of the mechanical equivalent of heat. His paper was read March 17, 1851, before the Royal Society of Edinburgh.[2] In a briefer but more general paper[3] he later gave general equations applicable to any deformation. Haga in 1882 completely verified Kelvin's equations for the special case of a stretched wire,[4] and later Wassmuth did the same for torsional deformation[5] and for bending.[6]

If an external pressure p exerted on a body decreases its volume v by the amount $\mathrm{d}v$ then the work done $\mathrm{d}w = p\mathrm{d}v$. But the total thermal energy generated in unit mass by this compression is

$$P\mathrm{d}v = C_p\mathrm{d}T \tag{1}$$

where P is the (thermodynamic) internal pressure, $\mathrm{d}v$ is change in

[2] Trans. Roy. Soc. Edinburgh **20**: 261–288.
[3] Phil. Mag., January, 1878.
[4] Wied. Ann. **15**: 1. 1882.
[5] Drude's Ann. **11**: 146. 1903.
[6] Drude's Ann. **13**: 182. 1904.

specific volume, C_p is mean specific heat at constant pressure and dT is the temperature change. Hence

$$\frac{dT}{dv} = \frac{P}{C_p} \tag{2}$$

This last is the celebrated Kelvin formula of 1851 for the change of temperature with compression. Equation (1) is given as a simple plausible approach, not a rigorously proven relation. In all strict derivations of this formula, unknown functions are introduced in the initial energy equations and these functions afterward determined by rather laborious mathematical thermodynamics. Thermodynamic internal pressure P, like absolute temperature T, is to be regarded as convenient semi-fiction, having a perfectly definite meaning but incapable of direct physical measurement. From simple physical mechanics it is evident that internal cohesive pressure is but one of four in equilibrium in any steady state. $p + P = \pi + \kappa$ where π is a distending pressure due to molecular resistance to compression and κ is the kinetic pressure due to heat motion, as intensively developed by T. W. Richards during the last 15 years. Perhaps thermodynamic internal pressure P is identical with the physical reality as Richards has assumed but the assumption appears unwarranted in the present state of development of the subject.

Since $dT/dp = dT/dv \times dv/dp$ and $dv/dp = v\beta$, the change of temperature produced by a change dp in external pressure is

$$\frac{dT}{dp} = \frac{T\alpha v}{C_p} \tag{3}$$

The ratio of the heat generated to the external work done is

$$\frac{dH}{dw} = \frac{C_p dT}{p dv} = \frac{P dv}{p dv} = \frac{P}{p} \tag{4}$$

simply the ratio of the internal pressure to the external pressure doing the work of compression.

In using any of these formulas, all energies must be expressed in the same units, either ergs or calories. One calorie $= 4.183 \times 10^7$ ergs. Pressures are in dynes/cm^2 and v and dv refer to specific volume (volume of unit mass). C_p refers to unit mass.

If the body deformed be a wire or tape stretched by a weight, the thermal effect is a cooling since the internal cohesive pressure opposes

extension and thermal expansion is positive. A formula similar (in form) to (3) may readily be developed

$$\frac{dT}{dF} = -\frac{Tal}{C_p} \tag{5}$$

T is absolute temperature, dT the change in temperature caused by the weight or tension dF in dynes. a is the expansion per degree and l the length per unit mass (cm/gm). This formula has been completely verified by every observer who has determined a and C_p on the specimen actually used.

To illustrate the magnitude of the various factors involved, the following table has been computed from data selected from a magnificent set obtained with a steel tape hung in the Washington Monument by C. E. Van Orstrand and his assistants in April, 1907, and unfortunately still unpublished. I have selected the lengths observed 4 minutes after the load was applied. Readings, all taken near that temperature, are corrected to 7.5°C. hence T = 280.6 absolute. The dimensions of the tape were 14685 × 0.640 × 0.0165 cm. = 155.07 cc. Section 0.01056 cm², density 7.70, mass 1194 grams, length/mass 12.30 cm/gm. The specific heat was taken as 0.115 cal/gm/deg throughout. The coefficient of expansion was taken as .00001185 for small loads and varied considerably with the strain as indicated.

TABLE 1.—THERMODYNAMIC DATA ON STEEL TAPE

Load (Kg)	*Yield (cm)*	*Temp. Drop.*	*Yield (cm/Kg)*	*Ext. work (Ergs/gm/10 Kg)*	*Ht. Loss (Ergs/gm/10 Kg)*	*Thermal Expn.*	*Internal Tension (Kg)*
10	7.67	.085	.7670	31468	408600	11.85×10^{-6}	129.8
20	15.37	.17	.7685	31591	413400	11.99	130.9
30	23.09	.29	.7697	31706	576800	16.73	181.9
40	30.85	.44	.7712	31838	721000	20.91	226.5
50	38.63	.55	.7726	31969	576800	16.73	180.4
60	46.45	.65	.7742	32100	456700	13.24	142.3
70	54.31	.73	.7759	32240	413400	12.00	128.2
80	62.20	.82	.7775	32371	408600	11.85	126.2
90	70.12	.90	.7791	31519	408600	11.85	125.6
100	78.08	.99	.7808	32658	408600	11.65	125.1

The yield per kg increases slightly but steadily with the load, 5 times as much as would be accounted for by the decreased cross section, indicating a progressive weakening of the structure. The thermal effect per kg on the other hand goes through a pronounced maximum at a 30 kg load. The external work done by each kg increment

in the load is given in the fifth column and the corresponding thermal effect in the sixth. The latter is computed from the temperature change, mass and specific heat. Mechanical and thermal energies are reduced to the same unit, ergs per gram per 10 kg increment in load.

The thermal expansion for this tape under small loads was taken as .00001185 per degree and this value in equation (5) gives a temperature drop of .085 degree for a 10 kg load as observed. Since this is the chief variable in the expression (5) for dT/dp, it has been computed in the seventh column assuming T, l and C_p as constant. The results indicate a maximum expansion per degree (.0000209) at a load of 30 kg, hence a maximum yield to internal kinetic agitation is given by but a moderate deformation (0.2 per cent). Steel treaters find a (compressive) deformation of about 8 per cent best conducive to crystal growth on annealing.

In the last column are given the internal tensions developed by stretching computed by a formula precisely similar to (4). These values are simply those of the sixth column divided by those of the fifth and multiplied by 10 to give tension in kg. The maximum tension developed (226.5 kg) is not far below the breaking strength of the tape. At the higher loads there appears to be an interlocking of the grains which relieves this tension somewhat.

It is of interest to compute the two remaining pressures of the four which are in equilibrium within the tape at each load. The applied tensions (loads) and the opposing cohesive tension P were given above. The kinetic repulsive pressure $\kappa = T\ \alpha/\beta$ is readily computed from the absolute temperature T and the coefficients of thermal expansion (α) and the tensile yield (β). Contact pressure π is obtained by difference. All are in kg.

TABLE 2.—THE INTERNAL PRESSURES IN STEEL TAPE

p	P	π	κ	$\alpha \cdot 10^6$	$\beta \cdot 10^{12}$
10	129.8	56.1	63.7	11.85	53.29
20	130.9	57.4	63.5	11.99	53.40
30	181.9	82.4	89.5	16.73	53.49
40	226.5	107.1	109.4	20.91	53.59
50	180.4	81.2	89.2	16.73	53.69
60	142.3	61.9	70.4	13.24	53.80
70	128.2	54.5	63.7	12.00	53.92
80	126.2	53.4	62.8	11.85	54.03
90	125.6	53.0	62.6	11.85	54.14
100	125.1	52.7	62.4	11.85	54.26

From an engineering standpoint, the cohesive tension P is likely to be of considerable interest. It gives information as to the nature of the yield under stress not given by Young's Modulus, the elastic limit, or Poisson's ratio.

The formulas given above, (2), (3) and (4), are readily adapted to geological problems involving heating by compression and rupture. Those applicable to shear and friction will be developed below. Since compressibilities are low and compressions small, even at rupture, volume changes are small. Since no elastic or thermal properties are very uniform throughout a mass, only rough values can be obtained. If the volume change be given, the corresponding temperature change is readily computed from (2). v is the volume of unit mass and dv the change in specific volume. If the thermal expansion and compressibility of the material in question are not available, we may take for a rough (maximum) value of P the crushing strength, and for the change in temperature $dT = Pdv/C_p$ even though the compression be but a small fraction of the elastic limit. For example, a rock having a crushing resistance of 10,000 lbs/in^2 ($= 68.90 \times 10^7$ dynes/cm^2) and a specific heat of 0.20 calories per gram (basalt, sandstone, granite, limestone) would change in temperature by 0.82 degree for $dv = 0.01$ cc. For a rock of density 2.5 gm/cc the specific volume is 0.40, hence for $dv = 0.01$ cc. the compression is 2.5 per cent. A compression of 1 per cent would mean a temperature elevation of 0.33°C.

If pressure instead of compression be known, either (3) or (4) may be used to compute dT and the calculation offers no difficulty.

For the work done and the heat generated in overcoming friction, the relations are simple and the thermal quantities involved are small. If F is the force required to move one surface over another and W the force pressing the surfaces together, the coefficient of friction, $k = F/W$, irrespective of the area in contact. The work $FS = kWS$ is required to push one surface a distance S over another. This is $FS/A = kWS/A = kW_1S$ per unit area where A is the area and W_1 the weight per unit area or pressure. In the absence of deformation away from the contact plane and of grinding at the contact, this work per unit area is equal to the heat developed per unit area H_1 ($= H/A$) $= kW_1S$. For example, take $W_1 = 1000$ lbs/in^2 ($= 68.9 \times 10^6$ dynes/cm^2), a displacement of 1 cm ($S = 1$) and $k = 0.20$. Then $H_1 = 13.8 \times 10^6$ ergs $= 0.33$ calorie/cm^2. This is sufficient to heat a layer of ordinary rock 1 cm thick 0.8°C. Other distances of slip and other pressures would give thermal effects in direct proportion. If grinding

occurs, the thermal effect may readily be calculated roughly from (4) taking for P the crushing strength.

The thermal energy developed by shear appears never to have been observed or computed. A theoretical formula may readily be derived from Kelvin's original general equations[7] for any deformation whatever by making five of the six coördinates constant and taking the variation of the remaining one (an angle) in its relation to energy developed and the thermal effect. But this formula involves properties of a body not readily determinable and for practical purposes it is better to treat shear as distributed friction.

If any plane slides a distance S over the next plane and the average thickness involved is t, then S/t is the angle of shear. The work done is $H_1 = kW_1S$ as above. The number of slip planes in unit thickness is $1/t$. Hence the work done in unit volume is kW_1S/t or simply $kW_1\alpha$ where α is the angle of shear. Taking $k = 0.7$ and $W_1 = 10{,}000$ lbs/in^2 (limestone or granite) and $S/t = 0.01$, the work done $= 0.5 \times 10^7$ ergs $= 0.12$ cal per cubic centimeter corresponding to a temperature rise in average rock of 0.2°C. If the deformation is sudden to near the elastic limit the thermal effect might rise to five or ten times this, if moderate and slow it would be very much smaller.

GENETICS.—*The genetical constitutions of* Oenothera pratincola *and its revolute-leaved mutations.*[1]

FRIEDA COBB BLANCHARD, University of Michigan. (Communicated by H. H. BARTLETT.)

THE EARLY OCCURRENCE AND BEHAVIOR OF THE REVOLUTE-LEAVED MUTATIONS OF *Oenothera pratincola*

Several accounts of certain revolute-leaved mutations of *Oenothera pratincola* have been written in the past twelve years (Bartlett, 1915; Cobb and Bartlett, 1919; Cobb, 1921).[2] A better understanding of the genetical constitutions of these forms now calls for the present paper. The data presented in the earlier papers are explained by the constitutions then suggested; but further investigations with them and with closely related forms have provided an explanation both simpler and wider in application.

[7] Phil. Mag., January, 1898, equations 6, 8, 12, 13.

[1] Papers from the Department of Botany of the University of Michigan, No. 268. Received February 1, 1929.

[2] See list of references at end of paper.

The situation may be briefly summarized as follows: In 1912 seed was collected by Professor H. H. Bartlett from eight plants of *Oe. pratincola* growing wild near Lexington, Kentucky. The strains descended from these eight plants are morphologically alike, but one of them, designated as strain E, is genetically different from the other seven (of which strain C is used as a typical example).

Strain C produces in every generation a small number of mutations of several kinds. Mutations of some of these types occur also in strain E; but much more conspicuous in strain E is the great number of mutated individuals with a striking characteristic not occurring in the other strains. These characteristic mutations of strain E are of at least four distinct kinds, but all are alike in having narrow, strongly revolute leaves, and in producing nothing but revolute-leaved plants in their progenies.

As may be seen from Table 1, the cultures of the F_1 generation from plant E contained only a small number of revolute plants (only two in a progeny of 522), a number comparable to the mutations occurring in strain C. Of the four plants chosen as the parents of the F_2 generation, three still gave only moderate numbers of revolute mutations (approximately 8%, 6%, 11%); the fourth, which gave 51% revolute plants, is the "mass-mutating" line of strain E. We are still carrying in culture mut. *formosa* from this source (now in its 14th generation from the original plant E), but unfortunately the f. *typica* of the mass-mutating line has been lost. Brief descriptions of the revolute forms have already been published (Bartlett, 1915).

Mut. *formosa* is normally fertile and vigorous. As will be seen from Table 2, it gave in the F_1 progeny some plants of each of the other three revolute types; but in more recent generations it has been breeding practically true.

Mut. *albicans*, as it first appeared in the garden, was vigorous, but produced few good seeds. As shown in Table 2, the original plants of this form produced in the F_1 generation progenies consisting of three of the four revolute types (muts. *albicans*, *revoluta* and *setacea*) but *not* mut. *formosa*. After the season of 1915, the experiment garden was moved from Maryland to Michigan, and since that time the very few plants of mut. *albicans* which have been observed in the seed pans have failed to mature. Consequently, any unusual revolute seedling resembling this form has been recorded as mut. *albicans*, though it is very possible that they may not all have been alike.

Mut. *revoluta* was practically sterile as it first appeared. Table II

TABLE 1.—ANALYSIS OF THE PROGENIES OF THE ORIGINAL PLANT OF *Oe. pratincola* STRAIN E; OF FOUR OF ITS OFFSPRING (ONE OF THEM SHOWING MASS-MUTATION); AND OF THE F_2 PLANTS FROM TWO OF THE F_1 PLANTS. PLANTS NOT OTHERWISE DESIGNATED ARE F. *typica*.

Nature of culture	*Pedigree of parent*	*Analysis of progeny*							
		f. typica	*mut.* formosa	*mut.* albicans	*mut.* revoluta	*mut.* setacea	*Flat-leaved mutations*	*Percentage of revolute-leaved plants in culture*	*Percentage of mut.* setacea *in culture*
F_1 progeny of original plant of strain E	*Unknown*	517	0	1	0	1	3	0.4	0.2
F_2 generation	E—5 f. *typica*[a]	194	4	15	15	172	4	51	43
	E—19 f. *typica*	954	0	0	24	54	0	8	5
	E—25 f. *typica*	610	0	1	12	23	1	6	4
	E—43 f. *typica*	566	0	2	5	63	1	11	10
	E—36 mut. *latifolia*[b]	95	0	5	2	29	3+ 48 mut. lat.	20	16
F_3 in mass-mutating line	E—5—229 f. *typica*	226	10	57	54	644	5	74	62
	E—5—208 mut. *angustifolia*[c]	2	4	2	21	475	1	99	94
	E—5—208 mut. *angustifolia*[c] × E—5—229 f. *typica*	0	0	0	4	168	1	99	97
	E—5—229 f. *typica* × E—5—208 mut. *angustifolia*[c]	10	0	1	4	99	4	88	84
	E—5—229 f. *typica* × E—5—206 mut. *formosa*[d]	7	0	1	0	121	4	92	91
	E—5—229 f. *typica* × E—5—182 mut. *albicans*[d]	1	0	0	1	12	0	93	86
Total		286	14	61	84	1519	15	85	77
F_3 in non-mass-mutating line	E—43—89 f. *typica*	96	0	0	0	1	3	1	1
	E—43—72 f. *typica*	49	0	0	0	0	0	0	0
	E—43—74 f. *typica*	188	1	0	3	3	2	4	2
Total		333	1	0	3	4	5	2.3	1.2

[a] This is the origin of the mass-mutating line.

[b] See Bartlett, 1915, p. 443.

[c] Mut. *angustifolia* is a narrow-leaved (flat) mutation of *Oe. pratincola* which behaves exactly as f. *typica* in breeding.

[d] Crosses of this kind have repeatedly been demonstrated to give the same results as self-pollinations of the egg parents.

shows that the single F_1 progeny of this form consisted of muts. *revoluta, setacea,* and *albicans.* Since this culture was grown, no plant of mut. *revoluta* from self-pollinated plants of strain E has survived the seedling stage.

Mut. *setacea* differs from the other three forms in several respects—in fact, as will be shown later, it is in a class by itself, though revolute, and really differs more from mut. *formosa,* than the latter does from f. *typica.* As it first occurred, mut. *setacea* was not only difficult to

TABLE 2.—AN ANALYSIS OF THE PROGENIES OF THE FOUR REVOLUTE-LEAVED MUTATIONS OF *Oe. pratincola.* PLANTS NOT OTHERWISE DESIGNATED ARE F. *typica.*

Type of parent	*Pedigree of parent*	*Analysis of progeny*			
		mut. formosa	*mut.* albicans	*mut.* revoluta	*mut.* setacea
mut. *formosa*	E—5—199 mut. *formosa*	883	1	4	194
	E—5—206 mut. *formosa*	130	2	0	14
	E—5—199 mut. *formosa* × E—5—217 f. *typica*[a]	218	0	0	91
	E—5—206 mut. *formosa* × E—5—229 f. *typica*[a]	151	0	3	23
Total		1382	3	7	322
mut. *albicans*	E—19—67 mut. *albicans*		36	3	226
	E—5—182 mut. *albicans*		7	3	59
Total			43	6	285
mut. *revoluta*	E—5—190 mut. *revoluta*		1	17	5
mut. *setacea*	E—5—17 mut. *setacea*				140
	E—5—20 mut. *setacea*				8
	E—5—66 mut. *setacea*				31
	E—5—135 mut. *setacea*				14
Total					193

[a] Crosses of this kind have repeatedly been demonstrated to give the same results as self-pollinations of the egg parents.

cultivate, but, like mut. *albicans,* gave very few good seeds. Table 2, however, gives satisfactory evidence that this form *breeds true.* It differs from the other three revolute forms also in its extremely small size and in its great numbers. It will be observed in Table 1 that the difference between the mass-mutating and non-mass-mutating strains lies in the prevalence of mut. *setacea.* The other three revolute-leaved forms occur with about the same frequency in all lines of strain E; but the number of individuals of mut. *setacea,* compara-

tively moderate in the other with three lines, is excessive in the fourth, or "mass-mutating" line.

Upon their first appearance, experimenting was begun with all four of these revolute-leaved mutations. Breeding data obtained from the three more sterile forms however, were few. Mut. *formosa* seemed more promising as material. And when the garden was moved to Michigan, after the season in which the F_1 generations of these forms were grown, it proved impossible to carry on any of the revolute lines except mut. *formosa*. Either the climate in Michigan is more unsuitable for these forms, or, more likely, the forms themselves are not as vigorous as at their first occurrence. Thus all attention since that time has been given to experiments involving mut. *formosa*. However, something has been learned of mut. *setacea* from its mere occurrence in progenies of self-pollinated plants of f. *typica* and mut. *formosa*, from its representative in hybrid cultures, and from its parallelism to a certain other form.

Results of Crosses between mut. *formosa* and f. *typica* of Strains E and C

An extensive series of crosses has been made between mut. *formosa* and f. *typica* of strains E and C. The results have already been published (Cobb and Bartlett, 1919; Cobb, 1921) but may be summarized as follows:

f. *typica* strain E × mut. *formosa*→f. *typica* (same progeny as self-pollinated f. *typica*)
mut. *formosa* × f. *typica* strain E→mut. *formosa* (same progeny as self-pollinated mut. *formosa*)
f. *typica* strain C × mut. *formosa*→f. *typica*
mut. *formosa* × f. *typica* strain C→f. *typica*, which instead of breeding true, produces in the F_2 generation a mixed progeny of the following proportions: 1 f. *typica*, true breeding; 2 f. *typica*, segregating in the next generation; 1 mut. *formosa*.

Inheritance, then, seems to be matroclinic in the cases of the first three crosses, and Mendelian in the fourth.

The Earlier Explanation of the Results of the Crosses

The earlier explanation adopted (Cobb and Bartlett, 1919) assumed: (1) that all the forms involved are heterogametic (i.e., formed by the union of two unlike gametes, an α gamete—usually the egg—and a β gamete—usually the sperm) and that there is among the fourteen chromosomes of each of the forms one (and the same) pair of freely segregating chromosomes; (2) that mut. *formosa* arises from f. *typica*

of strain E by a modification of a chromosome confined to the α group, giving to mut. *formosa* a factor for revoluteness of leaves in place of one for flatness in the other forms under consideration; (3) that, in the freely segregating pair of chromosomes, strain C carries a pair of dominant factors for flatness, which prevent the revolute character from appearing, (even though the α group with which they are associated has acquired the factor for revoluteness), and strain E and its mutation *formosa* carry the recessive allelomorphs of these factors—non-flattening factors, which do not prevent the revolute character from appearing in plants carrying the α which is modified by the factor for revoluteness (α'); (4) that the β group of chromosomes is identical in the three forms, the β gametes differing only in the factor for flatness carried in the freely segregating chromosome. It was assumed that the constitutions of the other revolute-leaved forms were similar to that of mut. *formosa*, though breeding experiments were insufficient to establish this. The constitutions of the three forms and their hybrids were therefore written:

Strain C,	$\alpha\beta$FF, flat, and, with respect to this character, immutable.
Strain E,	$\alpha\beta$ff, flat, mutable.
Mut. *formosa*,	$\alpha'\beta$ff, revolute.
Strain E × *formosa*,	$\alpha\beta$ff, flat, mutable.
Formosa × strain E,	$\alpha'\beta$ff, revolute, breeding true with respect to this character.
Strain C × *formosa*,	$\alpha\beta$Ff, segregating with respect to mutability.
	1$\alpha\beta$FF, flat, immutable, breeding true.
(Strain C × *formosa*) F_2,	2$\alpha\beta$Ff, flat, continuing the segregation of the F_1 generation.
	1$\alpha\beta$ff, flat, mutable, otherwise breeding true.
Formosa × strain C,	$\alpha'\beta$Ff, flat, segregating with respect to revoluteness.
	1$\alpha'\beta$FF, flat, non-segregating.
(*Formosa* × strain C) F_2,	2$\alpha'\beta$Ff, flat, continuing the segregation of the F_1 generation
	1$\alpha'\beta$ff, revolute, breeding true.

Respects in which the Earlier Explanation is Unsatisfactory

There are three respects in which this hypothesis is somewhat unsatisfactory. First, it assumes that the factor for revoluteness arises anew in strain E every time a revolute-leaved plant is produced—that each plant is, in truth, an original mutation. Second, it assumes both a factor for flatness, with an opposed factor for revoluteness (both confined to the α assemblage of chromosomes and therefore matroclinically inherited), and a factor for flatness with an allelomorph merely non-flattening in its effect, (as opposed to one producing revoluteness) in a freely segregating pair of chromosomes. Third, the F_2 generation of one of the crosses recorded (Cobb, 1921, page 8) failed to show the few revolute-leaved plants expected by this hypoth-

esis, though in all the other crosses made the hypothesis completely satisfies the facts. Under the new hypothesis it is easy to explain this "discrepancy," and this will presently be done.

A New Hypothesis Offered

A new hypothesis, hereby presented, assumes that strains C and E are alike in constitution, except that β of strain E carries a recessive factor for revoluteness, and β of strain C its dominant allelomorph for flatness. These β factors have no allelomorphs in α; the chromosomes of α and of β are not mates. As far as known, the α groups of chromosomes are identical in the two forms.

Also, because of a "weakness" (Blanchard, 1926, p. 148) of the α eggs, for some unknown reason, the β gametes of strain E function more frequently as eggs than is normal for the species. Strain C has occasional functional β eggs. These, when fertilized by β sperms, as normally happens, give homogametic plants ($\beta\beta$), and as seems often to be the case when the two gametes are genetically alike, the plants are poor dwarfs ("runts") which attain a height of only a few inches and seldom even flower. Strain E produces a much larger proportion of functioning β eggs. In this strain the homogametic plants thus produced are homozygous for the recessive factor for revoluteness and are therefore revolute-leaved mut. *setacea*, the dwarf member of the revolute-leaved series of mutations.

Mut. *formosa*, however, the revolute-leaved plant used most extensively in the experiments, is not, like mut. *setacea*, a homogametic plant. The new hypothesis assumes that, in f. *typica* of strain E, that particular chromosome of β which carries the factor for revoluteness has, on several rare occasions, been exchanged (by whole-chromosome crossing over) with a chromosome of α. This results in an α gamete carrying, in place of one of its seven chromosomes, the β chromosome which bears the revolute factor. Such a gamete, fertilized, as it would be, by a normal β gamete, gives a heterogametic ($\alpha\beta$) plant homozygous for the factor for revolute leaves. This is mut. *formosa*.[3] In the most unstable line of strain E, this phenomenon (the production of mut. *formosa*) has occurred approximately once in a hundred plants produced. This hypothesis, then, requires the functioning of a β egg, rather than an original mutative change,

[3] Aside from making this form (mut. *formosa*) revolute-leaved, the only known effect of this β chromosome in α is to increase in it slightly the general characteristics of homogametic ($\beta\beta$) plants (Blanchard, 1926).

for the production of each plant of mut. *setacea;* and a breaking away of one chromosome of a linkage group, rather than an original mutative change within a chromosome, for the production of each new plant of mut. *formosa* from f. *typica.*

Though the β chromosome bearing the revolute factor, or its allelomorph, has ordinarily (i.e., in f. *typica*) no mate in the α group, it does find a mate in the identical β chromosome acquired by the α gamete of mut. *formosa.* Doubtless these two chromosomes segregate freely in mut. *formosa,* but since they are identical there is no visible evidence of the segregation.[4]

If, now, this α gamete of mut. *formosa,* bearing as it does a β chromosome carrying the revolute factor, is fertilized by a β gamete carrying the allelomorph for flatness (such a gamete as β of strain C) there are brought together two chromosomes differing only in a single factor. Mendelian behavior follows.

Mut. *setacea* is not only homogametic but also completely homozygous. Instead of fourteen different chromosomes, it has seven chromosomes in duplication. Just as in mut. *formosa* the two identical chromosomes are presumably freed from α and β bondage and become an independent pair, so in mut. *setacea* the assumption is that all of the chromosomes pair.

The constitutions of the plants under discussion may now be written in conformity with the new hypothesis. When a factor is confined to the α or the β group, the symbol is so placed as to indicate the fact. Symbols of factors in freely segregating chromosomes are separated from the α and β signs. F represents the dominant factor for flatness: f, the recessive factor for revoluteness.

f. *typica* strain C = αFβF
f. *typica* strain E = αFβf
mut. *formosa* = $\alpha\beta$ff

$$\text{mut. } \textit{formosa} \times \text{f. } \textit{typica} \text{ strain C} \rightarrow \alpha\beta\text{fF} \rightarrow \begin{cases} 1\alpha\beta\text{FF (flat, breeding true)}^{5} \\ 2\alpha\beta\text{Ff (flat, repeating the segregation)}^{5} \\ 1\alpha\beta\text{ff (revolute)}^{5} \end{cases}$$

[4] Since this paper was written, Dr. C. G. Kulkarni has made a cytological examination of mut. *formosa,* and finds a ring of 14 chromosomes instead of a ring of 12 plus a pair, which is what one might expect. However, the breeding data accord so well with the hypothesis herein developed, and the correlations of the cytological findings with the genetical are still so little worked out, that one may look forward confidently to a future harmonization of the results.

[5] In all of these plants, the α eggs carry one chromosome which has a mate in any *pratincola* β sperm.

Consideration of the Single Case in which the Original Hypothesis Seemed at Variance with Results Obtained

The true-breeding flat-leaved plants of the F_2 generation of the cross shown above, those of constitution $\alpha\beta$FF have been designated "f. *typica* strain M (homozygous)" (Cobb, 1921). It was the cross f. *typica* strain E × f. *typica* strain M (homozygous) which gave a result (previously referred to) not quite in accordance with the expectation of the old hypothesis (Cobb, 1921, page 8). This cross is here written out, first with the constitutions originally suggested, and then with the newly adopted constitutions.

A. Old Formulation

f. *typica* strain E ($\alpha\beta$ff) × f. *typica* strain M ($\alpha'\beta$FF)→$\alpha\beta$Ff→

- 1$\alpha\beta$FF (flat, true breeding)
- 2$\alpha\beta$Ff (flat, repeating the segregation)
- 1$\alpha\beta$ff (flat, *except* for a few plants revolute-leaved *by mutation* (since it contains the mutating α of strain E and neither of the flattening factors), and producing revolute-leaved plants with the same frequency as does f. *typica* strain E)

The plants of the F_2 generation, which should have given progenies containing some plants revolute-leaved by mutation, failed to do so. This was the only case in which the original hypothesis did not seem fully to fit the facts, and further study seemed necessary (Cobb 1921, page 9).

B. New Formulation

f. *typica* strain E (αFβf) × f. *typica* strain M ($\alpha\beta$FF)→αFβF

- Only flat-leaved, *never* revolute-leaved plants, since the factors for revoluteness are entirely absent from the plant.

As a matter of fact, the F_2 progenies from eight F_1 plants of this cross, totalling over 6,000 plants (Cobb, 1921, table 20, page 35) contained, as would now be expected, not a single revolute-leaved plant. According to the old hypothesis there might well have been, (by mutation of α to α') several hundred.

Summary

In brief, the behavior of *Oe. pratincola*, in respect to its revolute-leaved mutations, is now explained more simply and satisfactorily than formerly. Instead of a condition of high mutability to revoluteness in α of strain E, and a pair of factors for flatness in a pair of freely segregating chromosomes in strain C and their non-flattening allelomorphs in strain E, the new hypothesis requires only a single origin of the factor for revoluteness as a mutation in β of strain E, and an allelomorph for flatness in β of strain C. This explanation does not require any free pairing of chromosomes in *Oe. pratincola* f. *typica*, but does require one pair of independent—or at least homologous—chromosomes in mut. *formosa*.

Mut. *formosa* is thought to originate by a whole-chromosome cross-over, when (very rarely), at reduction division, and α egg of f. *typica* strain E acquires that β chromosome which bears the factor for revolute leaves. The fertilization of such an altered α egg by a normal β sperm results in a zygote with a pair of identical chromosomes, which are thereafter free of α and β bondage.

Further, the constitution of the dwarf mut. *setacea* is concluded to be $\beta\beta$, and its occurrence in such numbers in the "mass-mutating" line to be due not to "wholesale modification of female gametes" as at first suggested, but to the unusual functioning of β eggs in this line.

As strain E was collected from the wild in 1912 it differed from the other strains collected at the same time only, so far as known, in having in β the factor for revolute leaves. In the second garden generation, the progeny of one (E-5) of the four F_1 plants used as parents showed "mass-mutation"—the production of a large proportion of $\beta\beta$ plants. The β gamete which went into the constitution of E-5 was relatively "strong" as an egg, or (more probably) the α was unusually weak, and approximately half of the functioning eggs were β gametes. The other three progenies were normal, i.e., they did not show mass-mutation. In these three lines the revolute-leaved mutations occurred with about the same frequency as do the flat-leaved mutations in the other strains of *Oe. pratincola*. As far as *Oe. pratincola* is concerned, therefore, the phenomenon called mass-mutation by Bartlett has been satisfactorily explained. The other case of mass-mutation, that of *Oe. Reynoldsii*, will doubtless have as simple an explanation. In this conclusion Professor Bartlett concurs with the writer.

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PALEONTOLOGY.—*A fossil member of the family Pegididae.*[1]

JOSEPH A. CUSHMAN, Sharon, Massachusetts.

Heron-Allen and Earland have recently described several species belonging to four new genera, and all included in a new family which they have called Pegididae.[2] The species present some very unusual forms and are from shallow tropical waters. These authors make the following note. "The wide distribution of the family in tropical seas would appear to connote a prolonged ancestry. Geological records at present give no evidence on this point so far as our own information goes. It is possible that early stages of the family's evolution may yet be found in tropical deposits, but, on the other hand, it must be recognized that coral sands and gravels such as the family now favours do not readily lend themselves to fossilisation."[3]

In view of this note, it is interesting to record a fossil species. One of the best known later Tertiary faunas which has essentially a shallow-water tropical character is that described from Kostej, Banat, Hungary, by Karrer.[4] This fauna contains many Miliolidae, including *Articulina* and *Hauerina*, with *Peneroplis* and *Spirolina* together with other forms of generally shallow-water tropical relationships. A considerable amount of material from Kostej in the writers possession was searched, with the result that a species of *Pegidia* was found, the first fossil record for the family. It is here figured and described.

Pegidia karreriana Cushman, n. sp.

Figs. 1 *a-c*

Test free, unequally biconvex, dorsal side more convex than the ventral; three chambers visible from the surface forming an irregular spire, earlier

[1] Received February 7, 1929.

[2] *On the Pegididae, a new family of Foraminifera.* Journ. Roy. Micr. Soc. **1898**: 283–299. *pls. 1–3, 1 text fig.*

[3] Op. cit., p. 288.

[4] *Die miocene Foraminiferen-fauna von Kostej im Banat.* Sitz. Akad. Wiss. Wien. **58**(1): 111–193. *pls. 1–5.* 1868.

chambers concealed by these three later ones, slightly inflated, fairly distinct from the ventral side, less so from the dorsal side except when wet; sutures not well marked, on the ventral side fairly distinct, on the dorsal side the suture between the last-formed chamber and the two preceding marked by a raised ridge; wall thick, on the ventral side smooth, on the dorsal ornamented by a series of irregular knobs; apertures consisting of a series of rounded pores along the region of the sutural line on the ventral side of the test.

Diameter 0.40 mm.; height 0.32 mm.

Holotype (Cushman Coll. No. 10,244) from the Miocene, Kostej, Banat region of Hungary.

At first glance, the surface resembles that of *Sphaeridia papillata* Heron-Allen and Earland, but the structure places it in *Pegidia*. Of the species of *Pegidia*, it is nearest to *P. pulvillus* Heron-Allen and Earland, but the surface is more coarsely ornamented and the biconvex form of the fossil species more

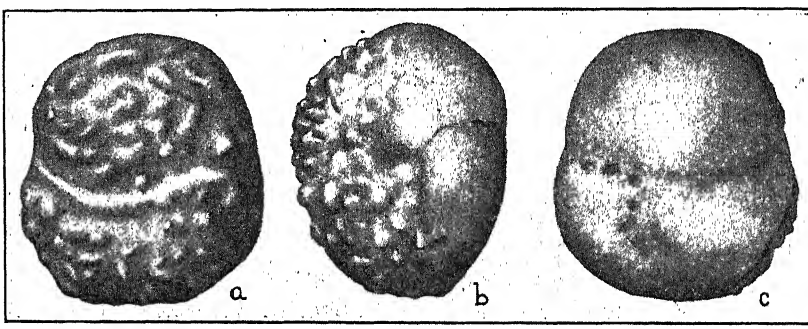

Figure 1.—*Pegidia karreriana* Cushman, n. sp., × 90. *a*, dorsal view; *b*, peripheral view; *c*, ventral view.

nearly symmetrical than in the recent one. *P. pulvillus* is described from DISCOVERY Station 283, off Annobon Island, Gulf of Guinea, 18–30 meters, from coral sand.

At first, it was thought that "*Discorbina turris* Karrer" described from Kostej might be the early stage of this species, but "*D. turris*" was found in the material and seems to be quite different with its ornamented ventral side and larger number of chambers.

This family contains some very queer forms and they appear to be exceedingly rare. They seem to have been derived from such genera as *Eponides*, *Lamarckina* or forms of *Discorbis* by a greater involution of the chambers. The development of a peculiar thickened plate which is finally perforated to form the apertures recalls somewhat the plate-like structure seen in *Cancris* and *Baggina*, the latter genus also becoming strongly involute. The peculiar perforated area of

Cancris lateralis (*Pulvinulina lateralis*) may be noted in this connection. The Pegididae are very closely related to this particular branch of the Rotalidae, but the relationship to the Globigerinidae mentioned by Heron-Allen and Earland seems much more remote. It is true that *Candeina* has rows of pores along the sutures, but it is not through a special plate as in these groups. The Pegididae have evidently become specialized in another direction, and instead of becoming thin, large-apertured, with delicate spines and fitted for pelagic life, have adopted a very heavy, thick test, with a reduction of the aperture to a minimum, adapting themselves thus to the rough treatment received in rather swift currents and coarse bottom sediments.

The genus *Physalidea* with two species, each described from single specimens, needs more material to show its exact relationship to the other genera included in the Pegididae.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE ANTHROPOLOGICAL SOCIETY

On February 21, 1928, Mr. O. F. COOK, of the United States Department of Agriculture, addressed the Society on the subject: *Peru as a primitive center of agriculture.* The ancient Peruvians may be said to have attained the highest development of the art of agriculture, in their system of terracing and artificial placement of the soil. The cost in labor was enormous, but the improvements were permanent. The fertility of the soil was not lost by erosion, and may even have increased with the lapse of time. The terraced lands of the valleys of the eastern Andes undoubtedly have been cultivated continuously for many centuries and still are highly productive. The very specialized forms of agriculture and attendant arts in Peru indicate a very long period of development, and the indigenous character of the development is shown by facts of domestication.

The agriculture of the table-lands certainly was indigenous, since it was based entirely on the domestication of endemic high-altitude plants and animals, but there is nothing to indicate that the agriculture of the tropical valleys was derived from other regions. Primitive people who took refuge in these narrow, shut-in valleys of the eastern slopes of the Andes were under the greatest pressure to adopt a settled existence and to make every possible use of any local plants that could furnish food. The textile arts were carried to high degrees of perfection with cotton and other plant fibers, and with the wool of llamas, alpacas and vicuñas. As the higher elevations were attained, accurate knowledge of the motions of the sun became necessary, to determine the season for planting crops. The series of plant and animal domestications covered the entire range of habitable conditions, from the tropical lowlands, through the temperate valleys to the arctic climate of the high plateaus, where agriculture was carried above 14,000 feet.

The number of species of plants and animals that were domesticated and used in Peru was much greater than in Mexico or other parts of America. A list of 91 native Peruvian plant names was published in the Journal of Heredity for March, 1925, including all of the more prominent cultivated species. Most of the plants that were cultivated in other regions were also known in Peru, and may have been domesticated originally in the eastern valleys of the Andes. The ancient Peruvians had every plant that was of first-rank importance in other parts of tropical America. Many degrees of agricultural specialization are still represented in Peru among very primitive people, and may afford the best surviving pictures of early stages of human progress. Having recognized that Peru was a center of domestication, this fact may enable us to follow and interpret the development of agriculture and civilization in other parts of America.

On October 16, 1928, Dr. JOHN M. COOPER, of the Catholic University, addressed the Society on the subject: *Field Notes on the Ojibwa of northern Ontario.* He gave a short account of the results of visits made in September, 1928, to the Ojibwa bands living around Lake of the Woods and Rainy Lake in Ontario. The purpose of the trip was to trace the western distribution of a number of traits previously determined as existing in Quebec, James Bay, and Albany River areas. He found that the culture traits characteristic of the eastern Algonkian region extend to the Rainy River and Lake of the Woods district. Following are some of the features of the Rainy River and Lake of the Woods culture. The typical family hunting-ground complex obtains. There were formerly no chiefs. Pagak, Memegwecio, and the northern "fairies" are well known. Among the types of divination common are scapulimancy, scrying, and the beaver haunch, and bear kneecap methods. Among the common types of magic are the use of the bezoar, of the foetal inclusion, and of singing and drumming, to bring luck in hunting; the use of the buzzer, the bull roarer, the singed rabbit skin, and feather plucking, to bring cold and wind; the use of caribou teeth, duck head feathers, bit of the navel string, miniature nets, and the shoulder blade of the mudturtle, as cradle charms.

At least six different types of medicine men are distinguished. The Midewiwin is still in fairly full force as well as the cylindrical tent conjuring. Disease is cured by the herbalists and by medicine men, the latter sucking out the disease by the use of hollow goose bones.

At death the soul crosses a river on a pole to the village of the dead. Infants are carried over by a swan. Kijé Manitu appears to be very much more clearly envisoned by the Rainy Lake and Lake of the Woods pagans than by the Cree and Montagnais tribes farther north and east. He is supposed to be good and benevolent, and to be, as one Indian expressed it, "boss of the whole thing."

On Tuesday, November 20, 1928, Dr. MATTHEW W. STIRLING, Chief of the Bureau of American Ethnology, spoke to the Society on *The Acoma Origin and Migration Legend.* This legend tells the story of two girls, children of the Sun, who were nurtured in the darkness within the earth. They were given by their father two baskets containing miniature images by means of which they were to create all living things on earth. On their emergence into the light they began this work, creating also the gods which were to be of use to the people. One of the sisters gave birth to twins, sons of the Rainbow.

Eventually the two sisters quarreled and separated, one, Nautciti, going away to become mother of the white people. The other, Iatiku, married Tiamûni, one of the sons of her sister, and remained to become mother of the Acoma people. Each of her daughters when born was given a clan name. After helping her children for many years Iatiku finally left them to their own devices, after having given them full instructions as to their proper religious observances. They were told that they must travel southward until they reached a place called Hako which was to be their permanent home. Seven times they stopped and built their pueblo only to have catastrophe overtake them, when they would move on. During these periods many of their medicine altars, ceremonies and societies had their origin. Their mythological heroes were born and had their adventures. Other gods were added to their pantheon. Finally Hako was located and the present Acoma built on the rock where it now stands.

At the meeting of the Society on January 15, 1929, Dr. JOHN R. SWANTON discussed *A Newly Discovered Southeastern Indian Dialect.* Dr. Swanton stated that in 1908 Mr. David I. Bushnell, Jr. had published in the American Anthropologist, under the title "The Account of Lamhatty," the story of a Tawasa Indian who had been carried off captive by a foreign tribe in 1707 and had escaped to the frontier settlements of Virginia. As much of his history as this refugee had been able to communicate, for none of the neighboring Indians understood his language, was taken down by the Virginia historian, Robert Beverely, and it was this narrative, preserved among the Ludwell Papers by the Virginia Historical Society, which Mr. Bushnell placed in print for the first time. More interesting still was the copy of a map by the same man found on the opposite side of the manuscript. Mr. Bushnell also reproduced this and attempted an identification of the place names entered upon it.

During the past summer Mr. Bushnell learned of a letter referring to Lamhatty in the archives department of the Virginia State Library. It had already been published but he also obtained a photostat copy of the original from Dr. McIlwaine, custodian of the archives. While doing this work Dr. McIlwaine discovered an English-Indian vocabulary of 60 words on the back of the document with the heading "Sum words of his language explained," and he furnished a photostat copy of this along with the letter. Both letter and vocabulary were by Col. James Walker, into whose hands Lamhatty had first fallen. The letter covers much the same ground as Bevereley's narrative; it is the vocabulary which is of especial interest. This, along with the rest of the material, was turned over to Dr. Swanton for examination. During most of their later history the Tawasa formed a constituent portion of the Alabama and it was naturally supposed that their language was close to if not identical with Alabama, a supposition rather increased by a study of the place names on Lamhatty's map. Yet the vocabulary developed the surprising fact that if it is representative of the speech of the Tawasa tribe, old Tawasa was a Timuquanan dialect, related to the now extinct tongues of central Florida. It was, however, intermediate between the tongues of the Muskhogean group—Creek, Choctaw, Apalachee, etc.,—and the dialects of Timuquanan hitherto known to us. Dr. Swanton illustrated these resemblances by means of slides. He believes that this material adds the final argument to an already formidable amount of proof that the Timuquanan and Muskhogean languages are genetically related and should be combined.

JOHN M. COOPER, *Secretary.*

THE ENTOMOLOGICAL SOCIETY

405TH MEETING

The 405th meeting was held at 8:00 p.m., Thursday, November 1st, 1928, in the National Museum. President S. A. ROHWER presided. There were present 36 members and 20 visitors.

Mr. HERBERT H. ROSS, Assistant Entomologist, State Natural History Survey Division, Urbana, Ill., was elected to membership.

Mr. ROHWER, as Treasurer, stated that since the last meeting of the Society some of the outstanding obligations in connection with the entertainment of the foreign delegates to the 4th International Congress had been paid, but sufficient funds had not been collected yet to liquidate all of its indebtedness for this entertainment. He requested that members who have not responded to the request for funds give the matter their early consideration.

The president announced that a portion of the time immediately following would be set aside for consideration by the Society of the life and services of our recently departed Honorary President Dr. EUGENE AMANDUS SCHWARZ. He then called upon Dr. HOWARD, as Committee Chairman, to read a statement ordered by previous resolution of the Society and prepared by a Committee composed of L. O. HOWARD, H. S. BARBER, and AUGUST BUSCK. This is as follows:

Your committee recommends that the following statement be recorded in the minutes of the meeting:

The Entomological Society of Washington appreciates to the fullest degree that in the passing of Dr. Eugene Amandus Schwarz it has lost its most learned member, its most loyal and generous supporter, and the kindliest and most helpful of friends. The Society points with pride to the facts that Doctor Schwarz was one of its founders, that he held in the course of the years every office in which he could serve, and that the title Honorary President was created especially for him.

The Society feels that American entomologists should be grateful that this great soul has lived among them for more than fifty years, constantly in his quiet way influencing their trend of thought towards the very best methods and towards sound scholarship.

Signed: L. O. Howard, *Chairman.*
H. S. Barber.
August Busck.

A letter from Dr. NATHAN BANKS of Harvard University, Cambridge, Mass., to Dr. Howard, containing reminiscences and appreciation of Dr. Schwarz, was read by the Secretary and appropriate comments on it were made by Dr. Howard.

Dr. Howard then read a paper on Dr. Schwarz prepared by the above Committee, which will be published in full in a forthcoming memorial number of the Proceedings of the Entomological Society. Discussion of the paper and expressions of appreciation of the career of Dr. Schwarz were then given by McINDOO, ALDRICH, HYSLOP, CLARK, HOWARD, BISHOPP, HALL, POPENOE, BUSCK, MARLOTT, MANN, WEBB, SASSCER, and CAMPBELL.

The filling of the position of Honorary President, made vacant by the death of Dr. Schwarz, was discussed by Mr. BUSCK, who directed attention to the fact that Dr. Howard was the logical member of our organization to fill this position. By unanimous vote of the Society, Dr. HOWARD was then

made Honorary President and was called upon to preside over the remainder of the meeting. Upon taking the chair he addressed the Society briefly and informally, expressing his happiness over the honor and dwelling upon his life-long enthusiasm for the science of entomology and his loyalty to the personnel of our membership.

Regular program: Dr. F. L. CAMPBELL: *Some facts about chitin.* The chemical and physical properties of chitin and methods for its detection were described and exhibited. The differences between chitin and cellulose were stressed, because of erroneous statements in the entomological literature that cellulose occurs in the entocuticula of insects. The source and spread of this error was pointed out. Both the entocuticula and exocuticula of insects in the sclerites and in the intersegmental membrane contain chitin. Neither layer has ever been shown to be free from chitin or to consist of pure chitin. Consequently, no areas of the insect cuticula are non-chitinized, so far as we now know. Chitin in the cuticula is always accompanied by more or less carbohydrates and proteins, and often pigments (called collectively "incrustations"). Since hard cuticula after alkali treatment becomes flexible, since the natural flexible entocuticula contains much more chitin than the hard exocuticula, and since hard structures (like the ootheca of the cockroach) do not contain chitin, it was concluded that incrustations, and not chitin, are the cause of the hardness of sclerites. It was shown also that depth of pigmentation is not related to the percentage of chitin in a surface structure and hence can not be used as an index of the extent of chitinization. Since neither hardness nor pigmentation are related to chitinization, it was recommended that the descriptive term "chitinized," long used to characterize hard, pigmented sclerites, be abandoned.

It was shown that chitin occurs in the egg shell of a cockroach and a grasshopper, when the shell consists of the blastoderm membrane and chorion. Chitin occurs only in the former structure. The report of Wester that the peritrophic membrane of the American cockroach is chitinous was confirmed and the significance of this fact pointed out.

The staining reactions of pure chitin were briefly discussed and it was pointed out that chitin stains best with acid dyes, cellulose with basic dyes. The presence of incrustations may alter staining reactions.

Facts from the literature on chitin were drawn upon for description of its distribution in plants and animals, its sameness wherever it is found, its decomposition in nature with special reference to its occurrence in fossil insects and its indigestibility by mammalian digestive enzymes, and, finally, its possible usefulness to man. (*Author's abstract.*)

At the conclusion of the reading of this paper and after discussion by SNODGRASS it was decided by the Society that, because of the lateness of the hour, it would be better to defer further discussion of it until the beginning of the next meeting.

The Society was especially happy to have with us for the evening a distinguished visitor, the widow of the late Dr. CHARLES V. RILEY, former Chief of the U. S. Bureau of Entomology, and, on suggestion of Dr. Howard, the members by rising acknowledged her presence and the honor of her visit.

406TH MEETING

The 406th meeting was held at 8 p.m., Thursday, December 13, 1928, in the National Museum. President S. A. ROHWER presided. There were present 26 members and 13 visitors.

Mr. Rohwer stated that sixty dollars was yet needed to reimburse those members who had advanced funds in connection with the entertainment following the Ithaca meeting.

Mr Rohwer also reported that at a recent meeting of the Executive Committee it was agreed to transfer the reserve supply of the Proceedings from storage space in the National Museum now needed for other purposes to free storage in the Lemon Building, 1729 New York Avenue, N. W., as soon as possible after January 1, 1929. In view of the fact that the Museum has furnished free storage since 1910, it was ordered that a letter of thanks be sent to the Museum authorities in appreciation of the favor.

Regular program: Dr. Paul Bartsch, of the U. S. National Museum: *Field experiences with Cuban insects.* He presented in outline a general survey of the principal localites covered by his trip, then related a number of individual instances of collections made here and there and exhibited specimens in alcohol of some of the material obtained. Emphasis was placed on observations of the relation of insects to other zoological forms, notably tarantulas, millipeds, and scorpions. Instances were related of capture of tarantulas by hunting wasps (*Pepsis obliquerugosa* Lucas); of strife between scorpions (*Centruroides gracilis* Latr.) and tarantulas; of excessive stinging from colonies of wasps; and of butterflies (*Heliconius charithonia* L.) eaten in large numbers in caves by bats. He reported also on experiences with large millipeds (*Julus* sp.) that exuded a strong fluid with staining and burning properties quite similar to those of concentrated iodine.

These remarks were discussed by Snodgrass, Schaus, McIndoo, Bishopp, Campbell, and Ewing.

The next item of business was the regular annual election of officers for 1929. With Bishopp and Sasscer as tellers the following were duly elected: *Honorary President:* L. O. Howard; *President:* J. E. Graf; *First Vice-President:* A. C. Baker; *Second Vice-President:* F. C. Bishopp; *Recording Secretary:* J. S. Wade; *Corresponding Secretary-Treasurer:* S. A. Rohwer; *Editor:* W. R. Walton; *Executive Committee:* The officers and A. N. Caudell, C. T. Greene, T. E. Snyder; *Representing the Society in the Washington Academy of Sciences:* A. G. Böving.

During intervals between votes on the election of officers, the paper entitled *Some facts about chitin,* by Dr. F. L. Campbell, presented but not discussed at the last previous meeting due to lack of time, was brought up and discussed by Snodgrass, Ewing, Rohwer, Hyslop, and Campbell.

J. G. Sanders, of the Sun Oil Company of Philadelphia, gave reminiscences of meetings of the Society some twenty years ago, at which time he had served as Corresponding-Secretary-Treasurer and had charge of the reserve supply of the Proceedings. He referred appreciatively to associations of those years with some of the older men, notably Ashmead, Coquillett, Heidemann, Knab, Schwarz, and Piper.

J. N. Tenhet, of Truck Crop Insect Investigations of the Bureau, located at Chadburn, N. C., spoke briefly of his work in that State on tobacco insects, notably *Monocrepidius vespertinus* Fab., and *Horistinotus uhleri* Horn. He also took opportunity to express his appreciation of the courtesies shown him by the Washington entomologists, notably Hyslop and Morrison. His observations on Elateridae were then discussed by Hyslop.

C. F. W. Muesebeck, of the Gypsy Moth Laboratory, Melrose Highlands, Mass., described some of the recent work on parasites being conducted at Budapest and at summer field stations in various parts of Europe. He

mentioned also some of the difficulties of the work, the matter of alternate host factors, and the actual sending of the parasites. His observations on these parasites were then discussed by ROHWER.

B. A. PORTER, formerly of the Bureau's field laboratory at Vincennes, Indiana, and now of the Washington office, greeted the society and expressed pleasure at being able in future to attend all our meetings.

Mr. ROHWER discussed briefly the situation regarding the pink bollworm, the status of the $5,000,000 appropriation authorized last year, and certain features in connection with the quarantine work. He stated that on November 22, 11 pink bollworm larvae had been found in a single field, 5 miles from Odessa, Ector County, Texas, and that 10 of these larvae were found in one single boll and of the 10, 7 were dead and 3 alive. Very intensive scouting was being done in the seven counties where pink bollworm was found last year. These are known as the Western Extension, being that part of Texas which has only during a comparatively recent period been devoted to the growing of cotton and which connects on the east with the main cotton belt of the South.

J. S. WADE, *Recording Secretary.*

SCIENTIFIC NOTES AND NEWS

One result of the general prevalence of the "flu" during the last few months is seen in the extensive advertising of so-called remedies and alleviatives. The Food, Drug and Insecticide Administration of the U. S. Department of Agriculture, has listed over 650 preparations of this type and has already instituted action for misbranding under the Federal food and drugs act against approximately 114. Many manufacturers have voluntarily corrected their labelings to meet the requirements of the law. According to medical authorities there is no known drug or combination of drugs which constitutes a competent treatment for or preventive of influenza.

FRANK L. HESS, Chief Engineer, Rare Metals and Non-Metals Division, U. S. Bureau of Mines, expects to sail on the *President Cleveland* from San Francisco on March 15, on a professional trip which will take him to Shanghai, Canton, and other Chinese points, the Malay Peninsula, Burma, India, and probably Russia and other countries in Europe, returning to Washington about the end of the year.

The annual dinner of the Botanical Society of Washington was given March 12. Former Secretary and Mrs. W. M. JARDINE and Dr. and Mrs. BRANDES were honor guests at the reception; and Dr. BRANDES lectured on *Botanical Explorations in New Guinea,* illustrated with motion pictures.

ACADEMY OF SCIENCES

The Washington Academy of Sciences was organized in 1898 through the joint action of the Joint Commission and the component societies. It was incorporated February 18, 1898. Its objects are to (*a*) acquire, hold, and convey real estate; (*b*) hold meetings; (*c*) publish and distribute documents; (*d*) conduct lectures; (*e*) conduct, endow or assist research; (*f*) acquire and maintain a library; and (*g*) transact any business pertinent to an academy of sciences. It acts as the federal head of the affiliated societies. There is a vice-president from each affiliated society, nominated by the society and elected by the Academy.

On January 1, 1929, the membership consisted of 15 honorary members, 3 patrons, and 581 members, one of whom was a life member. The total membership was 599, of whom 391 reside in or near the District of Columbia, 174 in other parts of the continental United States, and 34 in foreign countries.

A list of the publications of the Academy follows on the next page.

Meetings are held as determined by the Board of Managers. The usual date is the third Thursday of each month, from October to May. The annual dues are $5. There is no entrance fee. Elections are annual, and are held by mail ballot in January. The annual meeting is held on the second Tuesday in January.

Officers of the Washington Academy of Sciences for 1929

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Vice-President representing the affiliated societies:

Anthropological
Charles L. G. Anderson
Archaeological.....Walter Hough
Bacteriological..Miss Alice Evans
Biological.........E. A. Goldman
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Chemical......Raleigh Gilchrist
Elec. Engineers....C. A. Robinson
Engineers.........Starr Truscott
Entomological........A. G. Böving
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Class of 1930	Class of 1931	Class of 1932
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F. B. Silsbee	F. E. Wright	A. S. Hitchcock

(The above 30 officers constitute the Board of Managers)

Board of Editors..J. B. Reeside, Jr., E. W. Woolard, Edgar T. Wherry

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Publications of the Washington Academy of Sciences

Proceedings

The Proceedings of the Academy was a serial publication which began in 1899 and extended through 13 volumes, terminating in 1911. The subjects treated pertain to Geology, Astronomy, Physics, Chemistry, Paleontology, Botany, Anthropology, History, Ichthyology, Entomology, Mammalogy, Ornithology, General Biology, and other sciences, mainly in a technical way.

Surplus sets of Proceedings are being distributed gratis to libraries and other institutions of recognized standing and are sold at a nominal charge to individuals. Application should be made to the Corresponding Secretary.

Journal

(Semi-monthly, except in July, August and September, when monthly.)

Vol. 1 (1911, July–December)............................ $3.00

Vol. 2 (1912) to Vol. 18 (1928), each..................... 6.00

Single numbers of the *Journal:* semi-monthly numbers, $0.25; monthly numbers, $0.50. Send orders to the Treasurer, R. L. Faris, Coast and Geodetic Survey.

Note: The 1927 "Red Book" was corrected to November 15, 1927. For this reason the Board of Managers decided not to issue a "White Book" in 1929. The above list of officers for 1929 may be inserted in the 1929 Red Book.

JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

Vol. 19 April 4, 1929 No. 7

PALEONTOLOGY.—*New Carboniferous invertebrates—I.*[1] George H. Girty, U. S. Geological Survey.

This paper contains descriptions of two brachiopods, two pelecypods and one gastropod from Arkansas, and one brachiopod from Kansas.

Streptorhynchus affine. n. sp.

Figures 5–11

Shell small, a width of 25 millimeters being the maximum.

The brachial valve is subquadrate, strongly transverse, somewhat contracted at the hinge, straight or emarginate along the anterior border. The convexity is low with, for the genus, a remarkably strong sinus which is narrow posteriorly but widens rapidly toward the front.

The pedicle valve is subconical and rather strongly elevated. It is gently curved from side to side and nearly straight from apex to points in the margin, but as the growth is more or less distorted, these statements are only of general application. The angle made by the cardinal area with the plane of the shell margins varies considerably; usually it is obtuse but it may be a right angle. The height of the area is of course largely determined by the height of the valve and in most specimens it is rather high. The area is often planate but as the beak is apt to be bent to one side or the other, or even backward (rarely forward), so the area is sometimes more or less curved. It is sharply defined on each side by an angular shoulder which in many specimens is emphasized by a depression or groove down the convex or anterior part of the shell.

The surface is marked by rather stout rounded radii which diverge rapidly so that the interspaces make room for frequent intercalations. The radii are rounded and closely arranged; they are generally rather thick but thicker in some specimens than in others. At points of intercalation they are separated by intervals of about their own width; elsewhere they are wider than the intervals. They appear in most specimens to be subequal, but in some the arrangement is more conspicuously alternating and in a few every fourth or fifth one is much stronger than those between. The radii are crossed by sublamellose concentric, crowded, incremental lirae, and varices of growth

[1] Published by permission of the Director of the U. S. Geological Survey. Received March 1, 1929.

are rather numerous though not very strong. In some specimens the concentric markings are sharply developed; in others they are obscure though this effect can sometimes be ascribed to abrasion.

The interior of the pedicle valve is devoid of septal plates and the dental plates are reduced to thick but low ridges. The apex of some pedicle valves is more or less filled in by a callosity. The brachial valve has a short, broad, bilobate, cardinal process and rather short, though stout socket plates which are bent so that for much of their length they are parallel to the hinge line.

Horizon and locality: Stanton limestone; cut on the Frisco railroad, $1\frac{1}{4}$ miles southeast of Fredonia, Kansas.

Streptorhynchus suspectum, n. sp.

Figures 12–15

Shell rather large, ovate. A large pedicle valve measures 45 millimeters in width, but most are smaller; some associated brachial valves on the other hand are even larger.

The pedicle valve is high and conical. The outline rounds inward rather strongly at the cardinal angles and the hinge is considerably shorter than the width in front. The growth is very irregular and no two specimens have the same shape. In some the apex is twisted to one side or the other or bent backward over the area (never in the opposite direction) and most have abrupt expansions and contractions, or flare in bell fashion at the margin. The area is high but variable. It makes an obtuse angle with the plane of the valves, though in some shells the angle is much wider than in others. The area is generally flat but may be arched, especially in the upper part. It joins the lateral slopes in sharp angles. The pseudo-deltidium is gently convex and very elongate, the height being several times the width of the base, the ratio varying, however, with the height of the valve.

The brachial valve varies in configuration though it varies much less than the other. In describing this valve I can but note the characters of the dorsal shells that occur at the same locality as the ventrals, for in only one instance have the two valves been found in conjunction. Many of the brachial valves are highly convex, rising to a very prominent umbonal region with a steep descent to the depressed beak which sometimes is almost bent in under the parts above. On the other hand, some specimens, mostly small ones, are rather flat and may even be concave in the umbonal region. Many are also marked with constrictions or undulations due to irregular growth.

The surface is crossed by extremely fine sharp radial lirae. On some specimens the interspaces are wider than the lirae; on others, because of more frequent intercalation, they are of about the same size and on many the lirae multiply rapidly over the marginal parts where they are especially fine and crowded.

The internal structures are not well shown by my specimens and my observations are somewhat contradictory. Where any evidence could be gathered at all it seemed in most instances to show that a median septum was absent in the pedicle valve; dental plates, in any strict sense, are also absent, though the edges of the delthyrium are thickened so as to form distinct dental pillars. On the other hand, in one specimen especially, the median line appeared to be signalized by a low thin ridge which though inconsiderable in height, was yet suggestive of a septum. Less pronounced manifestations of a like development were observed on other specimens, but externally all of the specimens present the same appearance and offer no grounds for discrimi-

nation. A rather common peculiarity, though a feature more perhaps of configuration than of structure, is that many specimens are flattened in the rostral region as if compressed and bear a rather deep, rather narrow indentation; this is received by the internal mold which in turn appears as if the shell there had been thickened into an elongated solid platform of irregular shape.

The associated brachial valves have a low blunt median ridge or septum and long and somewhat curved socket plates.

This species is rather clearly distinct from *S. ruginosum* by reason of its more elevated pedicle valve with its correspondingly narrower delthyrium, and it also has finer and more crowded radiating lirae. Some uncommonly low pedicle valves of this species may not differ appreciably from some uncommonly high pedicle valves of that; so also may the surface striae of that species be in some rare specimens almost as fine and crowded as the surface striae of this, but the generality of specimens differs markedly. In configuration *S. suspectum* is more like the species for which Hall and Clarke introduced the name *S. ulrichi*. They did not, however, describe *S. ulrichi* and by way of illustrating it gave but a single figure representing the interior of a pedicle valve. It was later described and figured by Weller and the data thus made available show that the surface striae of *S. ulrichi* are uncommonly coarse, in marked contrast to the surface striae of *S. suspectum* which are uncommonly fine.

Horizon and locality: Pitkin limestone; Fayetteville quadrangle, ½ mi. north of West Fork, Ark.; Eureka Springs quadrangle, eastern border of sec. 21, T 16 N, R 27 W., Ark.

Tetracamera neogenes, n. sp.

Figures 1–4

Shell rather large, subovate. Width greater than the length, the width in the largest specimens seen being 30 millimeters.

Pedicle valve ovate to pentagonal in shape, widest at about the mid-length. The convexity is high longitudinally but transversely rather low. The sinus is broad, subtending an angle considerably more than one-fourth but rather less than one-half that of the whole valve. The posterior end of the valve is nearly planate, but shortly the median part begins to be depressed, the depression becoming somewhat rapidly deeper and broader, producing thus a broad, flat sinus; the sides meanwhile remain nearly flat or are bent down slightly, near the margin. The shell is rather sharply folded downward at the sides of the rostral portion in almost planate areas which slope outward more or less making with the main part of the valve a distinct angle of more than 90°. In gibbous specimens the anterior part of the sinus is somewhat abruptly bent downward to a direction almost perpendicular to the plane of the lateral margins. The plications are broad, subangular, and moderately strong. They become deep and angular toward the antero-lateral margins, but in the posterior third of the shell they are rather obscure. Normally three occur in the sinus and four on each of the lateral slopes, the final one being the angle that defines the inflected areas on either side of the beak.

The brachial valve is highly convex, not much curved in an antero-lateral direction but strongly arcuate from side to side. In gibbous specimens the shell at the anterior margin is abruptly and strongly deflected to a direction almost perpendicular to the part that preceeded it. The fold is broad and

flat, occupying about one-third of the valve, the lateral thirds falling away strongly at the sides. The plications are broad, low and more or less rounded. Near the front of the fold they become strong and angular but in the rostral region they are more or less indistinct. Normally four occur on the fold and three on each side. The fold and sinus are not well defined superficially except near the margin, but the deflection which they produce in the line of junction of the valves is abrupt and strong.

The internal structures have not been ascertained in detail, but in essentials they agree with the genus established by Weller. The pedicle valve is provided with two powerful dental plates which are connected with the sides of the valve in the rostral region by buttress plates, one on each side. The dental plates converge toward the median line but meet the bottom of the valve before they meet each other. Consequently they are not supported on a septum to form a spondylium, unless, as the test is very thick such a structure is present but buried within the shelly mass; this is highly improbable. A slight ridge or septum passes down the median line, however, rising from the bottom of the valve between the dental plates. The brachial valve has a well developed median septum which apparently unites with the hinge plate much as in *Camarotoechia*.

Somewhat paradoxically, *T. neogenes* is in its specific characters much more nearly allied to *T. subtrigona*, the oldest of the *Tetracameras*, than to the species which are nearest in geologic age, though *T. neogenes* is considerably younger than any of them. It is smaller than *T. subtrigona* and has fewer plications differently distributed.

Horizon and locality. Pitkin limestone; Yellville quadrangle, near St. Joe, Arkansas.

Nucula elegantula, n. sp.

Figures 19–21

Shell large, strongly transverse, irregularly ovate to subtriangular in outline. The type specimen is 11 millimeters wide, 8 millimeters high and 6 millimeters thick. The convexity is moderately strong. The upper surface of the valves is gently arched but the dorsal margin is abruptly and strongly inflected both before and behind the beak. Shortly, however, these margins bend outward again, so that grooves are formed that rather sharply define a lunule and an escutcheon. These grooves also sharpen the angle made by the inflected margins with the upper surface. The lines thus formed in the side view, meet at the umbo in an angle slightly less than 90° though the outline of the shell, because the lunule and escutcheon project slightly, is a little greater than 90°. Owing to the conformation just described the beaks are very prominent. They are fairly large and strongly incurved; although owing to the obliquity of the axis of the shell the beaks are directed backward, they do not curve in either direction. The outline of the shell as a whole is comparable to a triangle, in which the ventral side is the longest, the anterior side shorter than the ventral side and the posterior side much shorter than either. The ventral outline is rather regularly and strongly convex. The lines defining the umbo are slightly concave; that on the posterior side meets the ventral margin almost in an angle, the anterior end being less abruptly rounded. The anterior and posterior outlines have a duplex character owing to the lunule and escutcheon which are partly visible in the side view and partly obscured.

The surface is marked by fine, regular, concentric striae.

N. elegantula is more similar to *N. illinoisensis* than to any Mississippian species. Its distinguishing characters are its larger size, more transverse shape, and more distinct lunule and escutcheon.

Horizon and locality: Fayetteville shale; Winslow quadrangle, 2 miles north of Cold Spring, Ark.

Deltopecten bellistriatus, n. sp.

Figures 22, 23

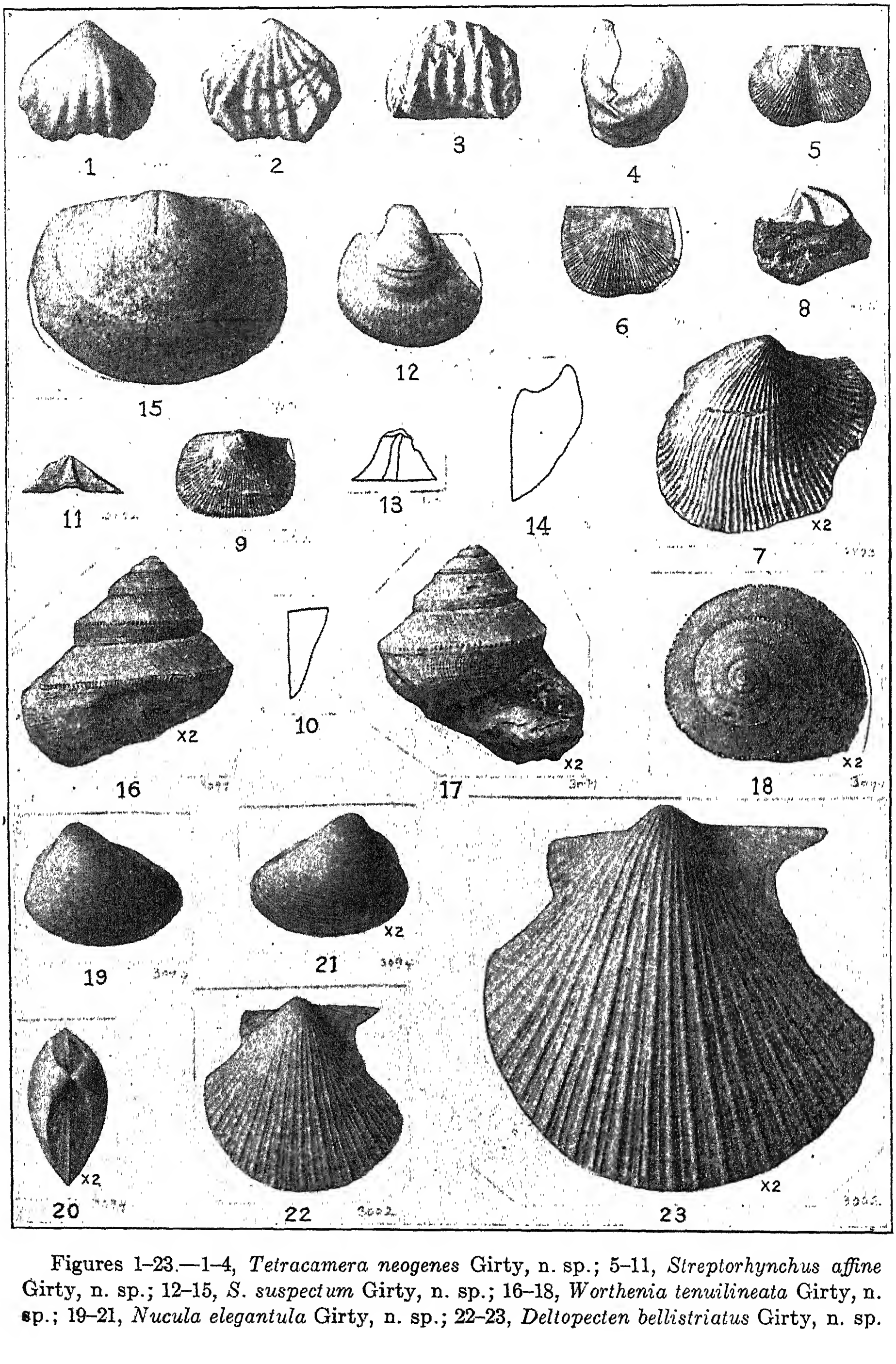
Shell of medium size, rarely 30 millimeters long. Greatest width below the middle, about equal to the length and about one and a half times the hinge line. Axis with a rather strong backward trend.

The left valve is rather convex for the genus, somewhat gibbous in the posterior part with short strong curvature to the beak and long gradual curvature to the ventral margin. The wings are much depressed, the anterior wing more abruptly than the posterior. In fact, the descent to the anterior wing in some specimens undercuts the shell above, forming a deep groove. The posterior wing, though not so abruptly depressed, is as usual, larger than the other. Owing to the configuration just described the body of the shell appears to be sharply defined from the wings and bounded by two nearly straight lines that make between them an umbonal angle of somewhat less than 90°. These lines extend downward beyond the wings, and meet more or less abruptly the broadly curved ventral outline. This curve is not symmetrical for it meets the anterior line at a point above its junction with the posterior line, and it sags appreciably on the posterior side. The projections of the wings above and of the body of the shell below form two broad, deep sinuses in the outline the anterior sinus relatively short and subangular, the posterior sinus relatively broad and rounded.

The surface is marked by costae and by concentric lamellose lines. The primary costae are coarse, and rise boldly from broad shallow interspaces. The interspaces however, are occupied by secondary costae much smaller than the primary ones; their number depends on their position, more being developed over the median part of the shell than over the sides. As many as 4 may occur in one interspace and they vary much in size according to the order of their appearance, those that came in first being almost as large as the primary costae, but those that came in last being very slender. Thus the costae conspicuously alternate in size over the median region but gradually become smaller and more uniform laterally. Those on the wings are especially fine, the transition being more or less abrupt. They are about nine in number and are nearly uniform in size, with only a few intermediate ones. On the body of the shell the intermediate costae are developed by intercalation though some of the large primary costae are double, being incompletely divided into two small ones by a shallow groove introduced on the crest. The concentric lamellose lines are fine and regular, much finer than most of the costae and somewhat more closely arranged. They are distinct on the interspaces and somewhat stronger on the costae, making conspicuous crenulations. Over the wings they are rather crowded though still regular, and these concentric lines as well as the radial ones are distinctly finer on the posterior than on the anterior wing.

The right valve is unknown.

This species is of the general type of *D. monroensis* but it is a larger shell, has a more elongate shape and much coarser sculpture with more conspicuously alternating costae. It resembles *D. batesvillensis* but differs consider-



Figures 1–23.—1–4, *Tetracamera neogenes* Girty, n. sp.; 5–11, *Streptorhynchus affine* Girty, n. sp.; 12–15, *S. suspectum* Girty, n. sp.; 16–18, *Worthenia tenuilineata* Girty, n. sp.; 19–21, *Nucula elegantula* Girty, n. sp.; 22–23, *Deltopecten bellistriatus* Girty, n. sp.

ably in the character of the sculpture which is coarser, the costae being not only larger but more widely spaced and hence less numerous.

Horizon and locality: Fayetteville shale; Marshall quadrangle, $\frac{1}{2}$ mile southeast of Marshall, Ark.

Worthenia tenuilineata, n. sp.

Figures 16–18

Shell rather large, consisting of 7 volutions. Spire somewhat low (about $\frac{2}{5}$ of the height) and somewhat turreted. Final volution strongly carinate; the carina, which forms the peripheral line and carries the slit band, is situated at about the mid-height. The surface above the carina slopes with strong obliquity from the suture. It is rather broad and is slightly sinuate in outline, a trifle swollen at the suture and gently concave toward the carina. The surface below the carina is directed obliquely downward and inward for a space about equal to the upper surface, then, upward and inward. The surface below the carina is much more highly arched than that above, concave at first for a short distance, then gently convex around to the impressed zone, without any abrupt change of direction. This configuration is confined to the last two volutions more or less, the earlier whorls, 4 or 5 in number, being more regularly rounded. The volutions embrace rather more than half the infra-carinal surface, so that the lower part of the shell is strongly turreted, but the upper part much less so. This difference is due to the rounded shape of the early volutions together with the rapid increase, absolutely if not relatively, in the surface left exposed below the carina by the overlapping whorls.

The surface both above and below the carina is finely cancellated by revolving and transverse lirae, though the upper surface is somewhat more coarsely marked than the lower. The revolving lirae of the upper surface, 13 or 14 in number, are not entirely equal in size or regular in arrangement, but on the

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Description of Figures

Tetracamera neogenes, n. sp. (p. 140).

Figs. 1–4. One of the cotypes. Pitkin limestone near St. Joe, Arkansas.

Streptorhynchus affine, n. sp. (p. 140).

Figs. 5–11. Several of the cotypes. Figure 5 represents an uncommonly indented and figure 6 an uncommonly flat brachial valve. Figures 7 and 8 represent a contorted pedicle valve and figures 9–11 represent a more symmetrical one. Stanton limestone near Fredonia, Kansas.

Streptorhynchus suspectum, n. sp. (p. 140).

Figs. 12–15. Two of the cotypes, one of them being a small pedicle valve, the other a much exfoliated brachial valve. Pitkin limestone in the Fayetteville quadrangle (figures 12–14) and in the Eureka Springs quadrangle (figure 15), Arkansas.

Worthenia tenuilineata, n. sp. (p. 140).

Figs. 16–18. The type specimen, × 2. Fayetteville shale, Eureka Springs quadrangle, Arkansas.

Nucula elegantula, n. sp. (p. 140).

Figs. 19–21. The type specimen, × 2. Fayetteville shale, near Cold Spring, Arkansas.

Deltopecten bellistriatus, n. sp. (p. 140).

Figs. 22–23. Two views, one enlarged 2 diameters, of the type specimen, a left valve. Fayetteville shale, near Marshall, Arkansas.

whole they are rather narrower than the interspaces. The transverse markings are more of the nature of lamellae than the revolving ones and are more closely arranged. They trend slightly backward from the suture and take on a more distinct retral curve as they near the carina. The points of intersection with the revolving lirae are marked by fine nodes. For a certain distance below the carina the revolving lirae are rather crowded because of small secondary lirae developed in the interspaces but toward the umbilicus they become somewhat larger and more uniform in size as well as more loosely arranged. The transverse lines are distinctly finer, fainter, and more closely spaced than those above the carina. Their course is doubly sinuate. Swinging strongly forward from the carina they shortly change direction so as to make a broad low arch; this is followed by a broad shallow sinus which in turn is replaced near the axis, by a backward curve.

The carina is formed by the slit band which is inclosed between two sharp edges or lamellae that distinctly define it. The band itself, however, is prominent, projecting beyond the bounding lamellae. It is conspicuously marked by strong, regular lunettes and also by revolving lirae, two in number, that are interrupted by the lunettes and appear only as two rows of small nodes connected by more or less obscure raised lines.

W. tenuilineata appears to be more nearly related to the common Pennsylvanian *W. tabulata* than to any Mississippian species that have been referred under *Worthenia*. In *W. tabulata*, however, the spire is more strongly turreted, the lateral surface is sharply defined by an angle from the lower, and the sculpture, especially that on the lower part of the volutions, is much coarser.

Horizon and locality: Fayetteville shale; Eureka Springs quadrangle, S. E. $\frac{1}{4}$ sec. 15, T 16 N, R 27W., Ark.

PALEONTOLOGY.—*Two new species of* "Orthophragmina" *from Calita Sal, Peru.*[1] WILLARD BERRY Johns Hopkins University. (Communicated by JOHN B. REESIDE, JR.)

In 1928 I assigned a new species of *"Orthophragmina"* to a new subgenus *Asterodiscocylina.*[2] Since that time other material from the same locality has yielded two more new species of *"Orthophragmina,"* which are described in this paper. Many specimens of *Asterodiscocylina stewarti* W. Berry were also included; several specimens of *Liothyina peruviana* of Olsson, who says that it is found in the Saman Conglomerate near Organo Grande and Quebrada Canoas, Department of Piura, Peru; and *"Orthophragmina" peruviana* Cushman, which is found in the Eocene at the horizon of the Saman Conglomerate. Tobler lists *"Orthophragmina" asteriscus* Guppy from a locality just south of Calita Sal at Punta Sal.[3] I have examined my material

[1] Received March 1, 1929.

[2] WILLARD BERRY. *Asterodiscocylina, a new subgenus of Orthophragmina.* Eclogae geol. Helvetiae **21** (2). 1928.

[3] A. TOBLER. *Neue Funde von obereocänen Grossforaminiferen in der nordperuischen Küstenregion.* Eclogae geol. Helvetiae **20**. 1927.

with a great deal of care and have failed to find any four-rayed species, but have found some small portions of six-rayed forms broken so as to resemble a badly preserved, possibly four-rayed form. On the basis of the associated fossils the beds containing the material here described are correlated with the Saman Conglomerate as described by Olsson and Iddings,[4] and by Olsson.[5]

The two species may be described as follows:

"Orthophragmina" (Discocylina) salensis, W. Berry, n. sp.

Figs. 1, 2

Test large, very thin, umbonate; diameter 5 to 9 mm., thickness 0.7 mm., ratio of diameter to thickness 13- to 1; small central boss 1 mm. in diameter, flange about 4 mm. in diameter. Surface covered with small papillae about 78 microns in diameter at the surface. Surface diameter of the lateral chambers 27.3 microns.

In equatorial section the nucleoconch composed of two chambers, the initial chamber 136.5 microns in diameter and half surrounded by the second chamber; diameter of the entire nucleoconch 292.5 microns, the walls of the nucleoconch very thin, being only about 7.8 microns thick. At about 1 mm. from the center the equatorial chambers of typical rectangular "Orthophragmina" shape, 35.1 microns in radial diameter, 19.5 microns in tangential diameter, with walls 5.7 microns thick; at the periphery, 78 microns in radial diameter, 15.6 microns in tangential diameter, with walls 7.8 microns thick; these chambers arranged in circles.

In vertical section the wall between the equatorial chambers and the lateral chambers 15.6 microns thick. Vertical diameter of the equatorial chambers 20 microns at the center of the test and constant to the periphery. Vertical diameter of the lateral chambers 82 microns near the central part of the test; thickness of the horizontal walls 35 microns. There are 15 lateral chambers on the sides of the equatorial layer near the center of the test.

Occurrence: In a grayish-brown, calcareous, gritty sandstone exposed near Calita Sal, Department of Piura, Peru. Associated with *"Orthophragmina" (Asterodiscocylina) stewarti* W. Berry, *"Orthophragmina" (Discocylina)) peruviana* Cushman and *"Orthophragmina" (Asteriacites) calita* W. Berry.

This species looks very much like *O. Clarki* Cushman and *O. pratti* Michelin but differs in having all the papillae the same size. It differs from *O. peruviana* in being very much thinner in proportion to the diameter. The paper-thinness of the test and the small, raised boss permit it to be easily recognized.

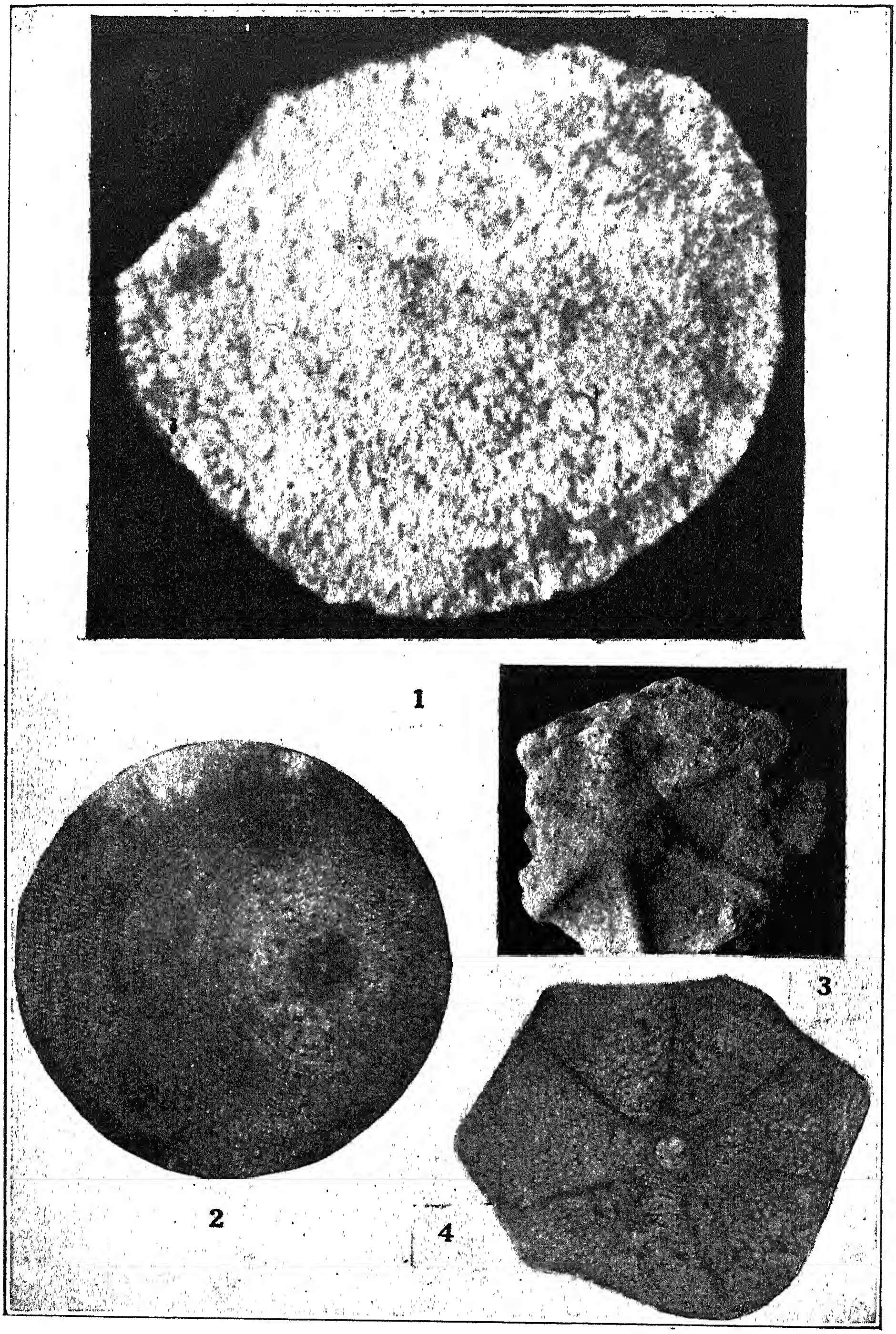
"Orthophragmina" (Asteriacites) calita W. Berry, n. sp.

Figs. 3, 4

Test medium, thin, stellate, typically six-rayed; rays connected evenly with the central boss; diameter from 4 to 6 mm., thickness 0.4 to 0.7 mm., ratio of diameter to thickness 8.6 to 1; central boss about 1.2 mm. in diameter, flange

[4] A. A. Olsson and A. Iddings. *Geology of northwest Peru.* Bull. Am. Assoc. Petr. Geol. **12**. 1928.

[5] A. A. Olsson. *Contributions to the Tertiary paleontology of northern Peru, Pt. I, Eocene Mollusca and Brachiopoda.* Bull. Am. Pal. **14** (52). 1928.



Figs. 1, 2.—*Orthophragmina salensis* W. Berry, n. sp. 1, surface of test ×10; 2, equatorial section ×20.

Figs. 3, 4.—*Orthophragmina calita* W. Berry, n. sp. 1, surface of test ×10; 2, equatorial section ×20.

2.3 mm. in diameter; rays fairly wide (0.4 mm.) and evenly curved or U-shaped; inter-ray areas level. Entire surface slightly reticulate; no evidence of any pillars. Surface diameter of the lateral chambers 78 microns.

In equatorial section; the nucleoconch composed of the initial chamber 109.2 microns in diameter, surrounded for about two thirds of its circumference by the second chamber; diameter of whole nucleoconch 218.4 microns, with walls 11 microns thick. Equatorial chambers normally rectangular, but elongated radially at seven places, giving rise to seven ray like series of chambers. Normal equatorial chambers at the center 31.2 microns in radial diameter, 19.5 microns in tangential diameter, with walls 9 microns thick; at the periphery, 46.8 microns in radial diameter, 19.5 microns in tangential diameter, with walls very thin, only 3 microns thick. Equatorial chambers of the "rays" at the center 46.8 microns in radial diameter, 19.5 microns in tangential diameter, with walls 7.8 microns thick; at the periphery, nearly the same size, 46.8 microns in radial diameter, 21 microns in tangential diameter, with walls 5.6 microns thick.

In vertical section the wall between the equatorial chambers and the lateral chambers 7.8 microns thick. Vertical diameter of the equatorial chambers 19 microns at the center of the test, increasing evenly to 43 microns in diameter at the periphery. Lateral chambers arranged in columns; vertical diameter 19 microns near the surface at the center of the test, the horizontal walls about 5 microns thick. There are a total of 18 lateral chambers on the sides of the equatorial layer near the center of the test.

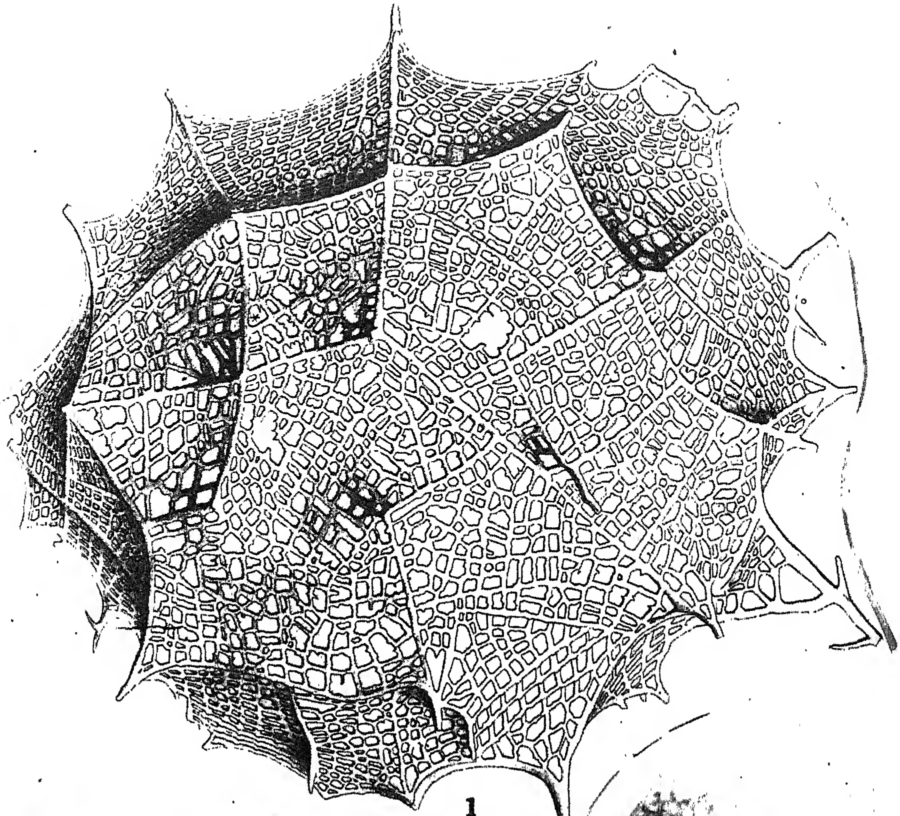
Occurrence: In a grayish-brown, calcareous, gritty sandstone exposed near Calita Sal, Department of Piura, Peru. Associated with "*Orthophragmina*" (*Asterodiscocylina*) *stewarti* W. Berry, "*Orthophragmina*" (*Discocylina*) *peruviana* Cushman and "*Orthophragmina*" (*Discocylina*) *salensis* W. Berry.

This species cannot be compared with any that I know of. Most of the described forms have the same number of interior and exterior "rays." In this species, however, there are constantly six surface "rays" and seven interior "rays." I have no sections of the six-rayed forms that do not show seven interior "rays."

PALEONTOLOGY.—*Two new larger Radiolaria from Peru.*[1] WILLARD BERRY, Johns Hopkins University. (Communicated by JOHN B. REESIDE, JR.)

The literature on fossil Radiolaria is relatively meager and predominantly relates to the smaller flask-shaped or conical forms of Nassellaria (Monopylaria) and Phaeodaria (Tripylaria). The discovery of two large related species belonging to the group which Haeckel christened Order Phaeosphaera is therefore of especial interest, not only because of their size but also because of their presence in large numbers in a shallow water deposit. The illustrations fall far short of doing justice to the exquisite beauty of the fossils, a beauty

[1] Received March 1, 1929.



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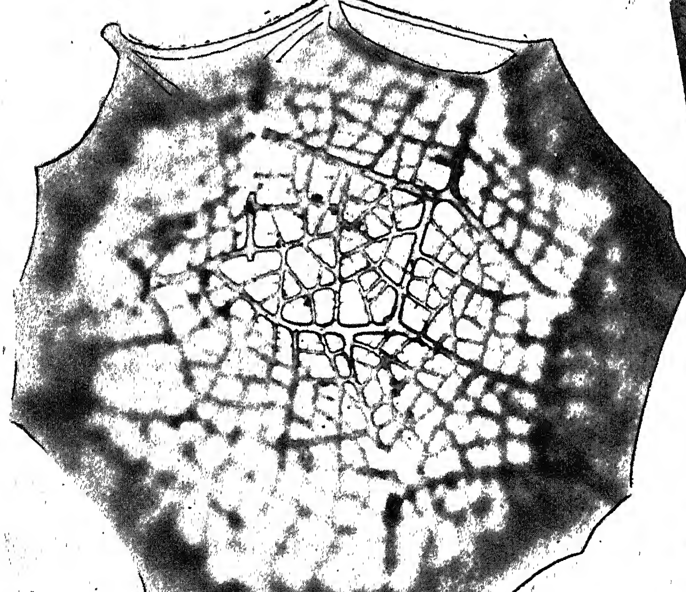

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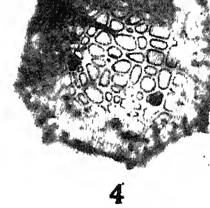

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which may be visualized by comparison with the accompanying copy of Haeckel's drawing of *Oroscena huxleyi*, a very similar existing species.

Members of the Phaeosphaera were first discovered by the Challenger Expedition and in his account of the Radiolaria Haeckel referred to the order 27 species in 4 genera. They are remarkable for their size, averaging from 1 to 3 millimeters in diameter. The tests are relatively coarse, mostly subspherical, and without special apertures. Haeckel speaks of them as rare and confined to great depths (1095 to 3125 fathoms), failing to recognize that the large size and spherical form stamp them as pelagic, surficial types—an indication which seems confirmed by the finding of the present species in abundance in shallow-water sediments. Presumably the material studied by Haeckel came from bottom samples of radiolarian ooze, but it seems remarkable that they have not been taken in tow nets, if indeed they have not, since they occur in all of the warmer oceans.

The present specimens came from a depth of 365 feet in a boring southeast of Bayovar, department of Piura, Peru, where they were associated with fragments of echinoid spines; tiny broken fishbones, vertebrae, and teeth; and numerous smaller foraminifera, including *Cristellaria*, *Textularia*, *Miliolina*, *Uvigerina*, *Nonionella*, and *Bulimina*.

The age is probably Pleistocene.

The new species may be described as follows:

Oroscena bayovarana W. Berry, n. sp.

Fig. 2

Subspherically polyhedral, averaging 1.5 millimeters in diameter exclusive of the radial spines. Lattice coarse both as to the aerolation and the size of the siliceous mesh. The coarser rods, 2 or 3 times the diameter of the finer rods, form rafter-like, somewhat concave ridges bounding the larger polygonal areas, which are pronouncedly concave. The lattice within the concave areas formed by the larger rods is made up of delicate rods subtending 3 to 5 sided areolae; and many of these rods bear one to several fine spines in the plane of the lattice, frequently extending half way across an areola. Where the larger rafter-like rods join, usually in threes but sometimes in fours, they curve outward like an A tent and form the base for a stout radial spine. In the fossil material these spines are all broken off a short distance above their bases, and it is impossible to determine whether they were simple or branched.

Fig. 1.—*Oroscena huxleyi* Haeckel, ×50, tropical Atlantic
Fig. 2.—*Oroscena bayovarana* W. Berry, n. sp., ×56, Peru
Fig. 3, 4.—*Oroscena peruviana* W. Berry, n. sp., ×30, Peru

This species is less abundant than *Oroscena peruviana*. In its general form it is closest to the existing *Oroscena huxleyi*, described from 2740 fathoms in the Atlantic west of the Canary Islands, but differs in its somewhat smaller size, larger meshes, and greater development of secondary spines.

Oroscena peruviana W. Berry, n. sp.

Figs. 3, 4

Nearly spherical, the average diameter near 1 millimeter. The rods of the lattice show less differentiation, being more nearly uniform in diameter, lacking concave areas bounded by larger rods. The angles of the mesh, and hence the areolae, are rounded. The radial spines are more numerous than in *Oroscena bayovarana* and relatively stouter, but all are broken off so that their distal character is unknown; they are smooth as far as preserved and the framework at their base does not recurve tentlike as in the associated larger species. An additional distinctive feature of *P. peruviana* is the smoothness of the rods of the lattice, no traces of lateral spines having been observed. This species is exceedingly common.

PALEONTOLOGY.—*Coleoptera from the lower Eocene (Wilcox) clays.*[1] H. F. WICKHAM, Iowa City, Iowa. (Communicated by EDWARD W. BERRY.)

Some time ago I received from Professor Edward W. Berry of the Johns Hopkins University, a small lot of coleopterous elytra from the Wilcox clays of lower Eocene time. As no Coleoptera are described from this horizon it has seemed worth while to characterize and name the material, even though it is insufficient to give any definite clues as to the climatic or other local conditions.[2]

Genus ELATER Linnæus

Elater berryi Wickham, n. sp.

Fig. 3

Represented by an elytron, 8.50 millimeters long and 2.75 millimeters wide, the extreme tip lacking. It is of narrow form, the sides sub-parallel for the major part of the length, the tapered portion so much injured that its proportionate size can not be measured. The surface is moderately finely

[1] Received March 1, 1929.

[2] It has always been a subject for comment that the remains of insects were so scarce in the fine grained clays of the Wilcox group which contain such a wealth of delicate plant material. In 1925 Dr. Collins described the wing of a termite (R. E. L. COLLINS. Am. Journ. Sci. 9: 406–410. *fig. 2*, 1925) and in 1927 I described the cases of a caddis worm (EDWARD W. BERRY. Proc. U. S. Natl. Museum, 71, Art. 14. 1927) from these beds. Professor Wickham has now described the few beetle elytra resulting from very intensive collecting during which over 500 species of plants have been obtained. We have a single wing of some hymenopterous form and other caddis cases which have not yet been described. *E. W. B.*

and evenly 8-striate, the striae finely but distinctly and regularly punctate. The interspaces are slightly convex and appear to have been minutely punctulate, but this may be due to the texture of the matrix.

Holotype.—Cat. No. 80474 U. S. Natl. Museum.

The specimen bears the collectors number 35, and was obtained 4 miles north of Jackson, Madison County, Tennessee. I think that there can be no doubt of its being an Elaterid. The generic name is used in the Linnæan sense.

Genus MELOLONTHITES Heer

Melolonthites collinsi Wickham, n. sp.

Fig. 4

Described from an elytron, 14.65 millimeters long by 6.05 millimeters wide, strongly declivous at the apex, with well defined outer marginal bead and two obtuse discal costae, outlined by punctures, similar to those of many recent species of Phyllophaga. The sutural margin is also beaded. Within it are two obtuse approximate costae, more distinct on the posterior half of length, where their limiting striae are finely punctured. The whole elytral surface is finely and diffusely punctate.

Holotype and paratypes.—Cat. No. 80475, 80476 U. S. Natl. Museum.

The holotype is marked with the collectors number 34, and is from the Holcomb Property, Henry County, Tennessee. The paratype shows both obverse and reverse, and is from 4 miles north of Jackson, Madison County, Tennessee. The specific name refers to the collector of the Henry County specimen, Dr. R. E. L. Collins.

I have looked in vain for anything in recent Scarabæidæ which will exactly match the costal arrangement and come back, after each search, to Phyllophaga, which the elytra strongly suggest. Probably the best course is to put it in Heer's genus *Melolonthites,* since there is too little shown to support a new generic name.

Genus OTIORHYNCHITES Heer

Otiorhynchites wilcoxianus Wickham, n. sp.

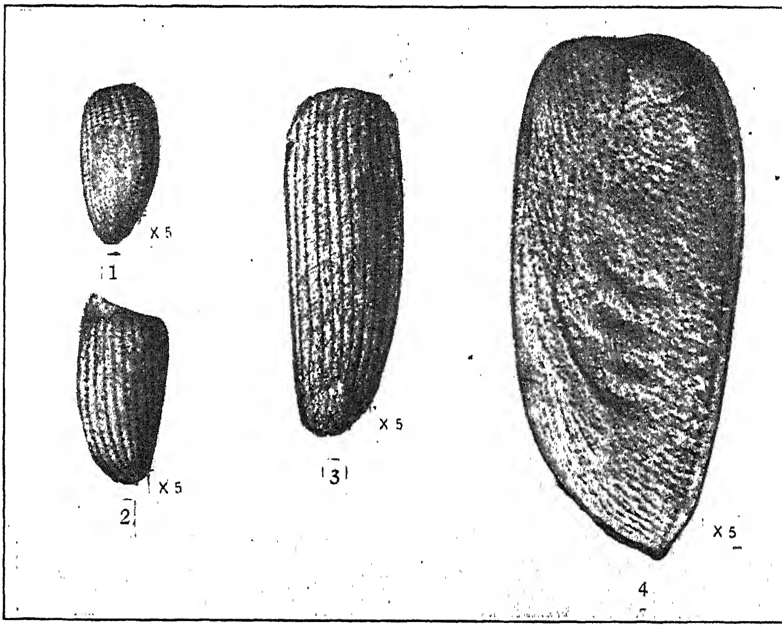
Figs. 1, 2

Based upon an elytron, 4.25 millimeters long by 2.35 millimeters wide, strongly convex, moderately arcuately narrowing to the tip. Surface regularly and rather deeply striate. Striae evenly and coarsely punctate for the entire length. Interspaces convex. The punctures of the external striae appear to be larger than those near the suture and on the discal region. However, the disk has been injured by abrasion so that the sculpture is effaced over a considerable area.

Holotype and paratypes.—Cat. Nos. 80472, 80473, U. S. Natl. Museum.

The holotype carries the collectors number 33, and is from the pits of the Texarkana Pipe Co., Miller County, Arkansas. A second specimen, designated as the paratype, is from the Bradley Pit, Henry County, Tennessee.

This appears to have been an Otiorhynchid weevil of the general form of the recent *Geoderces incomptus* Horn, but may have been even stouter. It is not possible to determine how much of the elytral width is due to flattening out of the original convexity.



Figures 1, 2.—*Otiorhynchites wilcoxianus* Wickham, n. sp., ×5
Figure 3.—*Elater berryi* Wickham, n. sp., ×5
Figure 4.—*Melolonthites collinsi* Wickham, n. sp. ×5

PHILOSOPHICAL SOCIETY

983D MEETING

The 983d meeting was held at the Cosmos Club, January 5, 1929, President ADAMS presiding.

Program: Address of the retiring president, Dr. PAUL R. HEYL: *The lingering dryad.* (This JOURN. **19**: 73–84. 1929.)

984TH MEETING

The 984th meeting was held at the Naval Observatory by invitation of the Superintendent, Capt. C. S. FREEMAN, on January 19, 1929. No formal proceedings were followed, but the members and guests were divided into four parties to inspect the various instruments and the exhibits illustrating the methods of computation and reduction of observations. Through the courteous attention of the guides and attendants, the work of this excellent scientific institution was vividly pictured to those present. All were grateful for such an opportunity on an ideal night.

985TH MEETING

The 985th meeting was held in the Cosmos Club, February 2, 1929, President Adams presiding.

Program: H. G. DORSEY: *The fathometer and apparatus used in radio acoustic ranging.* In any method of measuring ocean depths by sound waves it is necessary to have a sender, a receiver, an indicator, and usually a power plant.

In the type 312 fathometer the sender is called an oscillator. It is secured to the bottom of the ship when in dry dock and sends a compressional wave into the water whenever it is actuated by 525 cycle alternating current generated by a small power plant. The oscillator is about 13 inches in diameter and 4 inches thick. The diaphragm has a natural frequency of 1050 cycles when in water and is vibrated by the pull of each half cycle of the alternating current, doubling the frequency, since there is no polarizing field. The sender produces a sound at the bottom of the ship which goes to the bottom of the ocean and is reflected back as an echo.

The receiver, called a hydrophone, is similar to a telephone transmitter, made waterproof, and is located in a tank filled with water, inside the ship, the bottom of the tank being the ship's hull itself so that only the thin steel plating separates the water inside the tank from the water outside the ship. When the echo makes the diaphragm of the hydrophone vibrate, the motion changes the resistance of the carbon microphone and these resistance changes in an electric circuit produce an alternating current which is amplified to such an extent that it will produce a single instantaneous flash in a neon tube for each echo.

The indicator has the neon tube mounted back of a radial slot on a disc so that when the tube flashes a line of red light is seen through the slot. In front of the disc is mounted a transparent scale, graduated to 100 divisions. The disc is rotated at a constant speed of approximately four revolutions per second. Thus as a time measuring device each division represents one four-hundredth of a second, or 0.0025 second and the width of the divisions and sharpness of the edge of the slot enable one to estimate to a tenth of a division. The velocity of sound in sea water is roughly 4800 feet per second or 800 fathoms. Since the sound has to go through the water twice to produce an echo it goes through a depth of 400 fathoms in one second or one fathom in the time interval represented by one division of the graduated scale. Thus the indication is a direct reading in fathoms.

The shaft which rotates the disc also has a cam which closes, for a short interval during each revolution, the electric circuit from the power plant to the oscillator producing a short musical note in the water as the neon tube passes the zero of the scale. While the sound is going down and coming back the neon tube is rotating at a uniform rate and when the echo is received the exact instant is marked by the red flash. Since the disc is dark all the time except for the flash, depths are read as easily as telling time by a clock. If the depth is more than 100 fathoms it is only necessary to add a hundred for each revolution.

This method is used until depths are so great that the amplified echo can not operate the neon tube and then a change of gears and of the method are made so that a slowly rotating steady white line is watched and its position on a scale is noted when the echo is heard in a telephone receiver. By this method depths as great as 3000 fathoms have been measured.

Ten of the Coast and Geodetic Survey ships are now equipped with fathometers which greatly increase the speed of measuring depths. Besides measuring the depth, however, it is also necessary to know the ship's position if the depth measurement is to be of any value. This is usually determined by taking sextant angles of three shore signals, but the following method is also used.

The radio acoustic ranging method of locating a ship's position consists in firing a small bomb in the water by the ship and receiving the sound in hydrophones by two shore stations. The time of the explosion is recorded on a chronograph tape at the ship, on which are also recorded time intervals of seconds from a chronometer. Then when the sound of the bomb is received by the two hydrophones at widely separated shore stations a radio signal is automatically sent back to the ship by each station and recorded on the tape with the time and bomb records. The tape is moved at a uniform rate of about 2 centimeters per second by a battery-operated motor and the time intervals are readily measured to hundredths of a second.

The positions of the shore stations are accurately located by surveying and may be from 20 to 40 miles apart. Knowing the velocity of sound in water the three sides of the triangle become known and the triangle is soluble. By this method the ship's position may be determined even as far as 200 miles from shore and the great advantage is that the operation may be done in foggy weather or at night time when the shore is entirely invisible either due to lack of light or because of the earth's curvature.

It might be mentioned that radio acoustic position finding was started as a further development of World War work, aided by the United States Bureau of Standards and the United States Coast Artillery, as described in Coast and Geodetic Survey Special Publications No. 107 and 146.

The features of measuring the short time intervals involved in the fathometer were first described in the Journal of the Optical Society of America and Review of Scientific Instruments for September, 1924 and the instrument was patented by the author April 24, 1928. (*Author's abstract.*)

W. E. PARKER: *Echo-sounding and sound-ranging in hydrographic surveying and navigation.*

OSCAR S. ADAMS, *Recording Secretary.*

ENTOMOLOGICAL SOCIETY

407TH MEETING

The 407th regular meeting was held at 8 P.M. Thursday, January 3, 1929, in the National Museum. President J. E. GRAF presided. There were present 24 members and 16 visitors. The regular annual report of the Recording Secretary was read and approved and that of the Corresponding-Secretary-Treasurer was read and referred for audit.

Professor GEORGE A. DEAN, Kansas State Agricultural College, Manhattan, Kansas, conveyed greetings to our organization from the Kansas Entomological Society. He gave some data on the organization of the Society and the present interest in and demand for its recently established Journal. He also gave a résumé of the history of entomology at Kansas Agricultural College, its beginning in 1867 under the leadership of the late Professor B. F. Mudge and its continuance under Professor Riley, Professor Whitman, Professor Popenoe, Dr. Headlee, and others. A review also was given of the

entomological work at the State University from that of Dr. Snow in 1867 down to date. Some facts pertaining to the status of Kansas entomology were presented: Exclusive of student helpers, there are 24 active entomological workers in the various Kansas educational institutions and government research laboratories, while fully 100 Kansas men in various parts of the country are or have been actively identified with entomological work, including Williston, Kellogg, Marlatt, Knaus, Gahan, Aldrich, and Parrott. The U. S. Bureau now employs 16 Kansas State College men, 15 of whom were formerly Professor Dean's students. These remarks were commented on by GRAF and HOWARD.

Dr. WALTER CARTER, of the Bureau of Entomology Laboratory at Twin Falls, Idaho, also greeted the Society and gave a brief summary of work in the Northwest on the sugar beet leaf hopper and associated insects. He reviewed some of the methods in use, and analyzed some of the more important general factors bearing on the control of insects. These remarks were discussed by BAKER.

Dr. H. L. DOZIER, Agricultural Experiment Station, Newark, Delaware, gave a brief review of the history of entomological work in Delaware for some years past, from the work of Prof. Sampson in 1902 and of Prof. Holton in 1905 down to the present time, describing present entomological work in the State and his own laboratory and equipment. Comment on Dr. Dozier's remarks was made by HOWARD.

Dr. C. H. BATCHELDER, of the European Corn Borer Laboratory at Arlington, Mass., gave some of his impressions, more or less humorous in character, of the Society meeting and of the present entomological situation as a whole in this country.

Mr. A. W. CRESSMAN, of the Bureau of Entomology's Tropical and Subtropical Insect Laboratory at New Orleans, Louisiana, referred briefly to some of the problems in connection with his work on Rodolia Beetle and the camphor scale. The U. S. Bureau of Chemistry and the Bureau's Florida Laboratory are cooperating in an extensive program of investigations dealing with the physical characteristics of oils, emulsifications, etc.; and the perfecting of technique on the biological side of the problems, especially control of camphor scale and other scale insects by use of oils and oil emulsions and by fumigation. These remarks were discussed by HOWARD and MORRISON.

Dr. F. M. WADLEY, of the Insect Pest Survey of the Bureau of Entomology, expressed his satisfaction at being able, because of his recent transfer to Washington, to attend regularly the future meetings of our organization.

Mr. O. E. GAHM, of the Branch of Truck Crop Insect Investigations of the Bureau, spoke briefly of his recent transfer to Washington and of his present work at Arlington Farm on mushroom insects.

Mr. EUGENE D. EATON, of the Bureau of Entomology Laboratory at Carlisle, Pennsylvania, referred feelingly to some of the perplexities experienced by the beginner or near-beginner in entomology. He enumerated some of the difficulties encountered recently in connection with his work on Hessian fly and its parasites, especially those pertaining to such factors as climate and environment. Comments were made by GRAF and BAKER.

Regular program: Dr. N. E. McINDOO, of the Bureau of Entomology: *Tropisms and sense organs of Lepidoptera.* This paper was divided into two main divisions: Tropisms and Tropic Receptors. It was pointed out that zoologists and entomologists should say phototaxis, chemotaxis, geotaxis, etc., instead of saying phototropism, chemotropism, geotropism, etc. Under

phototaxis the following headings were mentioned: (*a*) Definitions and problems in study of light reactions; (*b*) are light reactions adaptive?; (*c*) is orientation accomplished by selection of trial movements?; (*d*) how do light rays bring about orientation?; (*e*) do circus movements support Loeb's theory?; (*f*) what wave lengths stimulate insects most?; (*g*) light traps are not yet considered successful; and (*h*) phototactic experiments on codling-moth larvae.

Chemotaxis, geotaxis, and thigmotaxis were also briefly referred to. Instead of saying that an insect is positively phototactic, negatively geotactic, positively chemotactic, and positively thigmotactic, it is better to say photopositive, geonegative, chemopositive, and thigmopositive.

The tropic receptors include photoreceptors, chemoreceptors, audireceptors, thigmoreceptors, georeceptors, and other receptors. Most of these were illustrated with lantern slides.

In Lepidoptera there are three types of so-called olfactory organs on the antennae: end pegs, pegs, and pit-pegs. Since no one has ever found nerves running to the end pegs, they should no longer be regarded as sense organs. If the pegs and pit-pegs are the only olfactory receptors in Lepidoptera, then 12 of the 34 individuals examined cannot smell, because these particular sense organs are totally absent. The organs called olfactory pores by McIndoo have been found on all adult and larval Lepidoptera yet examined.

The so-called taste organs are peculiarly shaped hairs situated on the distal half of the proboscis. Minnich's tarsal chemoreceptors in butterflies are also regarded as taste organs. This writer has shown that these organs, when properly stimulated, are 256 times as sensitive as are the taste organs in the human mouth.

Under audireceptors the following so-called auditory organs were briefly discussed: tympanic organs, chordotonal organs, Johnston organs, and auditory hairs. This talk was concluded by a brief discussion of tactile organs, balancing organs, and scent-producing organs. (*Author's abstract.*)

Owing to lateness of the hour discussion of Dr. McIndoo's paper was postponed until the next meeting of the Society.

J. S. WADE, *Recording Secretary.*

JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

Vol. 19 April 19, 1929 No. 8

ZOOLOGY.—*The genus* Trimosina *and its relationships to other genera of the Foraminifera.*[1] Joseph A. Cushman, Sharon, Massachusetts.

In 1907 Schubert, in a paper entitled *Beiträge zu einer natürlicheren Systematik der Foraminiferen*,[2] dealt with the relationships of *Chrysalidina* d'Orbigny and some supposedly related genera, some of which he proposed at that time. In my recent work, *Foraminifera, their classification and economic use*,[3] I followed in part the relationships proposed by Schubert. In the last year or more it has been possible to study abundant material of some of these rare genera and to gain a much more adequate knowledge of them. Schubert's work was based on published figures and descriptions rather than on an actual study of specimens. I have now been able to study all of these genera from suites of specimens, and some changes in the relationships as given by Schubert are inevitable.

The genus *Chrysalidina* d'Orbigny is monotypic, the Cretaceous species *C. gradata* d'Orbigny being the only one known, as *C. dimorpha* H. B. Brady was made the type of a new genus *Chrysalidinella* by Schubert. At the École des Mines in Paris, I was enabled through the kindness of Dr. H. Douvillé to examine a series of *Chrysalidina gradata* d'Orbigny. The wall of these specimens is arenaceous and the genus should be placed in the Verneuilinidae as a derivative from *Verneuilina*, the position indicated for it by Schubert. *Chrysalidina* is to be distinguished from *Verneuilina* by the numerous rounded perforations of the apertural wall instead of the narrow single aperture of

[1] Received March 1, 1929.

[2] Neues Jahrb. Min. **1907**: 232–260.

[3] Spec. Publ. 1, Cushman Lab. Foram. Research, 1928.

Verneuilina. So far as we now know, it is an end form, as are so many of the genera which have developed sieve-like areas in the apertural face. It is possible that the peculiar form described by Brady as *Bigenerina robusta* has developed from such a triserial ancestry and has assumed a biserial and in some specimens a uniserial development in its later stages, with a sieve-like apertural face. That this form is related to the Palaeozoic *Climacammina* is very improbable.

In his grouping, Schubert derived his genera *Chrysalidinella* and *Chrysalogonium* from *Chrysalidina*. These are calcareous forms and do not belong with the arenaceous *Chrysalidina*, which, as just noted, belongs in the *Verneuilinidae*. The genus *Chrysalidinella* Schubert is monotypic, based on *Chrysalidina dimorpha* H. B. Brady, a species of the tropical seas, at the present time practically limited to the Indo-Pacific but in the Tertiary more widely distributed. This species, the types of which I saw in the Brady collection in London and Cambridge, is calcareous and the early stages are related to *Reussia*, as I have shown. I now have abundant material from the Indo-Pacific showing both the microspheric and megalospheric forms. *Chrysalidinella* is triserial like *Reussia* in its early stages, but becomes uniserial later and has the terminal face with numerous perforations. It is known from the Miocene to the Recent, whereas *Reussia* is known from the Cretaceous and is still living in tropical regions. *Reussia* developed from *Bulimina*, but is distinguished from typical forms of that genus by its triangular shape. The bulimine aperture is, however, still retained.

From what we know of the development of the Foraminifera, a form should occur in which the triserial condition is maintained, but the terminal face should show a sieve-like aperture. Such forms are now found to be abundant in the Indo-Pacific and two new species are figured here from off Fiji. These may be referred to the genus *Trimosina* Cushman, the genoholotype of which is the form figured by Millett as *Mimosina spinulosa* Millett, var. This specimen and others I was enabled to study in the Heron-Allen and Earland collection in the British Museum. In his genus *Mimosina*, Millett included several forms which need much more study. The typical *Mimosina* based on *M. hystrix* Millett I studied in London. The adult is biserial while the young stages, difficult to make out, seem in the microspheric form to be planispiral. Whether this genus is related to *Hantkenina*, as I have placed it, or is a biserial form related to *Trimosina* and *Reussia*, can only be determined by a study of much more material

than is now available. In *Trimosina perforata*, n. sp., figured here, there is a long slit-like aperture with the apertural face having a series of pores. This is different specifically from *Trimosina milletti* Cushman in which the perforate plate is not well developed. That the two are closely related however cannot be doubted when both are studied. Another species from off Fiji, figured here, is more primitive and shows the development from *Reussia* in even more marked fashion. These species of *Trimosina* fill in very well the stages from *Reussia* to *Chrysalidinella*.

The genus *Chrysalogonium* Schubert was based on *Nodosaria polystoma* Schwager, from the Pliocene of Kar Nicobar. It is nodosarian in form but the terminal face has a sieve-plate instead of the typical radiate aperture. This has been the only species known, but in the last year I have had material which can be referred to this genus from as far back as the Upper Cretaceous as well as from other ages, and it can be definitely stated that the genus does not belong, as indicated by Schubert, in the line with *Chrysalidinella* nor in this family. That genus will be discussed in another paper.

The relationships of these various genera therefore are as follows—*Chrysalidina* d'Orbigny is arenaceous and belongs in the Verneuilinidae derived directly from *Verneuilina*. *Chrysalogonium* Schubert is not derived, as Schubert indicated, from *Chrysalidinella*. *Reussia* is derived directly from *Bulimina*, and in turn gave rise to the triserial *Trimosina* Cushman with a sieve-plate and to the uniserial *Chrysalidinella* Schubert.

A description of two new species follows.

Trimosina perforata Cushman, n. sp.

Fig. 1 *a*, *b*

Test small, generally triangular in both side and end views, angles acute; chambers triserial throughout, rapidly increasing in size as added, the angles of the chambers usually protruding and early chambers sometimes twisted; sutures distinct, not depressed, slightly limbate; wall calcareous, finely perforate with coarser perforations along the borders near the sutures connecting with the interior by definite tubules, generally smooth, thin and nearly transparent; apertural face convex, with numerous ridges and irregular projections, aperture consisting of a long narrow opening connecting with the basal margin by a narrow slit at a sharp angle to the axis of the main opening, bordered by a distinct thickened lip, the apertural face with numerous irregularly rounded openings.

Length, 0.50 mm.; breadth, 0.35 mm.

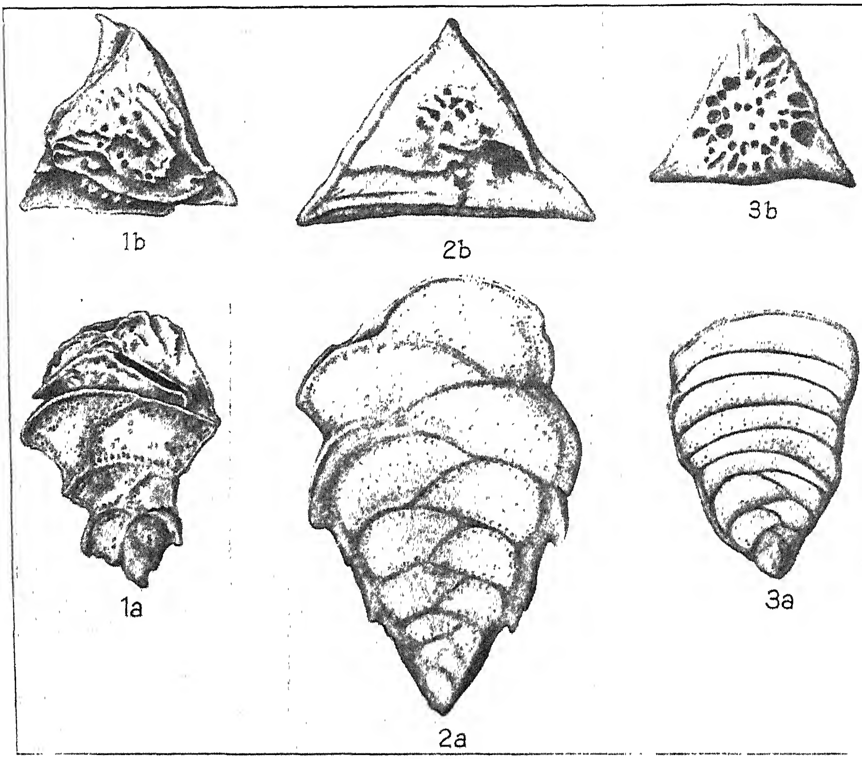
Holotype (Cushman Coll. No. 10363) from 40–50 fathoms off Fiji.

This species may be distinguished from the following by its very angular, coarser chambers, and the greater size of the sieve-plates.

Trimosina simplex Cushman, n. sp.

Fig. 2 *a*, *b*

Test of medium size, triangular in both side and end views, angles acute; chambers triserial throughout, uniformly increasing in size as added, angles of the chambers slightly spinose, the outer angle thickened, almost carinate; sutures distinct, not depressed, very slightly limbate, rather evenly curved;



Figs. 1 *a*, *b*.—*Trimosina perforata* Cushman, n. sp., *a*, front view; *b*, end view.
Figs. 2 *a*, *b*.—*Trimosina simplex* Cushman, n. sp., *a*, front view; *b*, end view.
Figs. 3 *a*, *b*.—*Chrysalidinella dimorpha* (H. B. Brady), *a*, front view; *b*, end view.
All figures × 75

wall calcareous, coarsely perforate, especially along the borders, smooth, fairly thick but translucent; apertural face slightly convex, fairly smooth, the aperture elongate without a lip, and with a few supplementary openings in the center of the terminal face.

Length, up to 1 mm.; breadth, 0.50 mm.

Holotype (Cushman Coll. No. 10365) from 40–50 fathoms off Fiji.

This species is a more primitive one than the preceding, and connects the other with *Reussia*.

In this same material from off Fiji at 40 to 50 fathoms, *Chrysalidinella dimorpha* (H. B. Brady) also occurs in the rather peculiar form shown here (Fig. 3 *a*, *b*). The sides are entire, the later chambers uniserial, and the terminal face with the apertures peculiarly arranged. There are probably several species of this genus which may be possible of separation.

Although all three of the species figured here occur together, they are distinguishable at a glance. The specimens of *Chrysalidinella* may be at once identified by the entire outline even before the uniserial chambers are noted. The two species of *Trimosina* are also strikingly different in general appearance. *T. simplex* has evenly placed and arranged chambers with small spinose projections extending backward at a decided angle, whereas *T. perforata* is a smaller but coarser form, the chambers relatively larger, the projections large and the whole test often twisted.

ZOOLOGY.—*The chromatropism of* Mermis subnigrescens, *a nemic parasite of grasshoppers.*[1] N. A. COBB, U. S. Department of Agriculture.

The adult female *Mermis subnigrescens,* when ripe for ovijection, has a way of moving her head in more or less horizontal curves;—her head, directed skyward, is waved in "circles," now clockwise, now the reverse. This seemingly purposeful behavior occurs when she emerges from the soil and while she is ascending the herbage to deposit her eggs. Inasmuch as the head of the egg-laying female,—unlike that of the *young* female as well as that of the male (neither of which ever quits the subterranean darkness),—contains *reddish transparent pigment* rather definitely distributed with reference to certain cephalic nerves, the question arose whether we do not have here a phototrope[2] and an

[1] Received March 12, 1929.

[2] It is suggested that the mechanisms through whose activation the responses of organisms termed *tropisms* find expression be called "tropes;"—"tropism" to be taken in almost any of its more or less well accepted meanings.

These meanings (interpretations of various investigators,—see Mast, 1915) vary all the way from (1) "*an inherent tendency to respond*" (Standard Dictionary), to (2) an "*irresistible*" or "*predictable*" *orientation as definite and mechanical as that of a magnetic needle;* but *whatever* the accepted interpretation, the *reaction-mechanism must always be present, and be a system* of intimately connected elements or organs, as is the digestive system, for instance, or the excretory system. Since we have for this system of intimately connected elements no inclusive single descriptive term, and since it is found highly convenient, or even necessary, for purposes of thought and discussion mentally to "isolate," and separately to denominate, the digestive system or enteron, and other systems, it is suggested that in behavior studies a like situation be met by a similar,

affirmative answer was forecast, for the obvious reason, among others, that, as the pigment must absorb certain light frequencies and transmit others, the absorption might well result in some such changes of energy as characterize vision. Very suggestive also is the fact that the transparent, colorless parts of the head immediately in front of, and alongside, the suspected phototrope condense light rays upon it. (See Fig. 1.)

Previous experiment showed the spectrum frequencies concerned in bringing about ovijection in this nema probably to be some of those in the light-blue and low violet region of the spectrum, together with red (also infra-?).[3] It would therefore be natural to suspect, under all the circumstances, that the cephalic pigment characteristic of the adult female absorbs, and "makes use of," the frequencies *present* just previous to and during ovijection. Hence a wish, (1), to determine what frequencies are present during and just previous to natural ovijection; and, (2) to determine what frequencies are absorbed by the cephalic pigment.

In this field comparatively little seems to have been published, though somewhat pertinent papers by Crozier, Mast, and others exist. Investigators have been mainly occupied with the optics of the various colorless, transparent, organic elements; the relative location and probable function of certain pigments, usually dark or black (opaque); and the "migration" and other changes of pigment, such as visual purple, due to the action of light; and, of course, with the associated nervous and contractile elements. Little has been published with regard to tropism definitely due to the absorption of rays of a *particular* frequency solely by transparent, colored pigment (other than visual

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but if possible better (to wit monosyllabic), terminology. The advantages of a monosyllable from which short, convenient adjectives, verbs, adverbs and other nouns can readily be derived, are almost too obvious to need mention,—tropic, tropically, to trope, troping, etc., etc. Most helpful, perhaps, will be its use as a component, e. g., in "chromatrope."

Primarily "trope" denotes action,—action that is in progress rather than completed. By metonymy the word denoting an action (here, what is called a reaction) may be applied to the (re)action-mechanism, i.e., in the present case, to the responding system of intimately connected organs.

Following this suggestion, we may speak of a reaction mechanism that aids or causes an organism to face toward or away from light, as a *phototrope;* a reaction mechanism used in orientation with reference to gravity, a geotrope, etc., etc., etc., etc.; thus the statocystic mechanism of crustaceans is a species of geotrope.

Accordingly, certain cephalic apparatus of *Mermis subnigrescens* is here spoken of as a phototrope; or, better, because more specific, as a *chromatrope,*—inasmuch as its reactions apparently are to definite frequencies (colors) of the solar spectrum. *Glaucotrope* γλαυκοσ = blue) may prove to be even more precise.

[3] *Species of Mermis.* Journ. Parasitology, **8**: 66. 1926.

purple) located definitely with reference to nerves, these nerves themselves so located as possibly to be sensory.

SPECTROSCOPIC TEST OF THE PRESUMPTIVE CEPHALIC CHROMATROPE OF *Mermis subnigrescens*

One-third of a millimeter of the front end of an adult female *Mermis subnigrescens*, including the head, was ligated and cut off, and then mounted on a microscope slide in water. The head was examined under a 1.5 mm. apochromatic microscope objective, having a similar objective as a condenser, in such a way that the image would fill as much as possible of the microscope field with the color of the pigment. (See Fig. 1.) The microscope was fitted with a spectroscopic eyepiece.

Sunlight was taken from a planished aluminum reflector placed so that a maximum of sunlight was reflected through both instruments,—*i.e.*, the above apochromatic-micro-spectroscope and a comparison spectroscope. The pigmented tissue was brought into focus, and then the iris diaphragm of the microscope thrown open, so as to admit a "flood" of light. This produced a spectrum fairly readily seen in a darkened room, notwithstanding the very high magnification.

Much of the violet end of the spectrum (well into

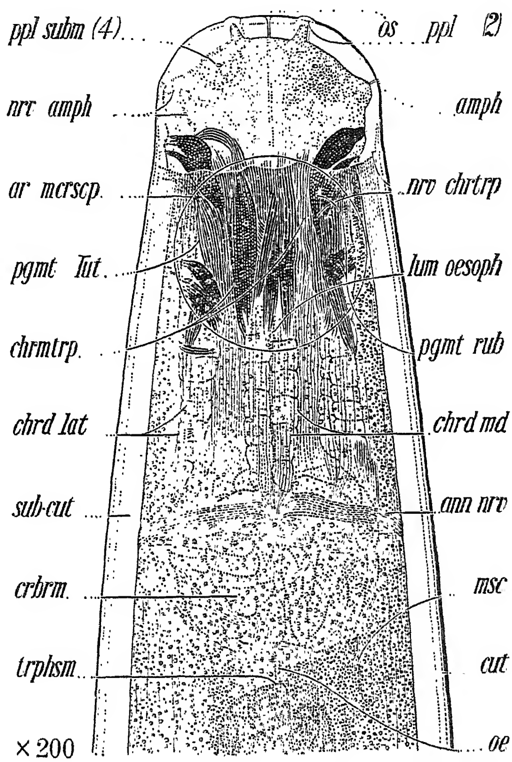

Figure 1. Head end of *Mermis subnigrescens*, showing the chromatrope. *os*, mouth; *ppl* (2), the two lateral so-called "papillae;" *amph*, amphid; *nrv chrtrp*, nerves of the chromatrope; *lum oesoph*, lumen of the oesophagus; *pgmt rub*, reddish pigment of the chromatrope; *chrd md*, median chord; *ann nrv*, nerve-ring; *msc*, body-wall muscles; *cut*, cuticle; *oe*, oesophagus; *ppl subm* (4), the four submedian papillae; *nrv amph*, nerve of the amphid; *ar mcrscp*, shows the circular area of the microscopic field that was tested spectroscopically; *pgmt lut*, orange-colored pigment of the chromatrope; *chrmtrp*, chromatrope; *chrd lat*, lateral chord; *sub cut*, the thick subcuticle; *crbrm*, the cerebrum; *trphsm*, anterior end of the trophosome.

the blue) was absorbed to a very considerable degree by the living cephalic pigment of the *Mermis subnigrescens*. The microscope field was never completely and uniformly filled with the color of the pigment. There were streaks at each margin of the field, and another through the middle, that showed little color (see Fig. 1), so that doubtless the absorption was not so pronounced as would be obtained by dissolved pigment of equal density filling the entire field of the microscope.

A satisfactory demonstration was made by placing the object under the microscope so as to produce absorption, and after the spectra had been arranged for comparison, suddenly removing the pigmented tissue. *The effect produced by this instantaneous change was very pronounced.* The blue and violet region of the spectrum, hitherto obscured by absorption, of course instantly assumed the same colors as in the comparison spectrum.

There seemed also to be some absorption in the outermost part of the red of the visible spectrum, but, if so, it was very slight. No absorption was noticed in the orange, yellow and green, and little if any in the bluish green.

The experiment was particularly satisfactory in that the pigment was *in a living condition.* True, the head had been ligated and cut off immediately before the spectroscopic examination, but from much experience it is known that such a head continues to live and move anywhere from a few hours to a day, or even more.

Phototropes of somewhat the character here described probably occur in the cervical region of many other nemas, particularly free-living ones,—the outer tissues of the neck serving as a cylindrical lens for condensing light upon the pigmented tissues. Aquatic nemas so situated as to utilize light rays penetrating water, not infrequently present structures that may be suspected to be phototropes,—now that we have a clue to the nature of such structures in this phylum. These primitive phototropes may well have been the forerunners of the more highly developed phototropes, ocellate systems, of certain nemas (e.g. *Enchelidium*).

A general review of the nature and relationships of localized transparent pigments in organisms in the light of the foregoing experiment, may, perhaps, suggest new ideas and experiments with regard to their functions both in animals and plants.

NATURAL CONDITIONS UNDER WHICH *Mermis subnigrescens* DEPOSITS ITS EGGS

At Woods Hole, Mass., U. S. A., on July 28, 1928, from long before daylight up to 10 o'clock A.M. the weather was warm and showery. The showers were gentle but subcontinuous, with light-intervals between; *i.e.*, during two or three brief intervals the sunlight actually came through the fog and clouds rather clearly.

Two full-grown female specimens of *M. subnigrescens*, very much alike, were found depositing eggs naturally on grass etc. in an experiment field. As each nema still contained a good many eggs, both were taken to the laboratory in cold tap-water, and both subjected to radiant heat of low frequency, emanating from hot steel. The results of three trials on one of the nemas and four on the other were quite consistent.

An ordinary steel file about nine inches long and three-fourths of an inch wide was heated until hot, though not red. As near as could be judged the temperature of the file during the trials was from 400°–500° C. The hot steel was held within an inch and a half to two inches of the nemas. Held at this distance from one's cheek, it caused an agreeable warm sensation;—no disagreeable sensation of heat, however,—no suggestion of scorching.

When the nemas were brought into the laboratory, both were still slowly depositing eggs; one, however, very slowly,—putting out only one or two eggs semi-occasionally. When one of these ten-centimeter nemas in this laboring condition was removed from water and stretched out on a broad-leaf plantain, *Plantago major*, and the hot file brought near, she immediately responded by increased rapidity of movement, and in from ten to twenty seconds became coiled, sometimes rather closely, so that the entire space occupied by her would not be over fifteen to twenty millimeters across. Barely enough water was used on the plantain leaf so that only at her points of contact with the leaf was she in contact also with water. Doubtless the warmth may have caused the water to evaporate a trifle more rapidly, notwithstanding the saturated condition of the atmosphere, and one cannot say that this change in rate of evaporation may not have had some effect on the behavior, but the inevitable inference is that the "radiant heat" caused the change in behavior, corroborating, in a reverse way, experiments of previous years with direct sunlight and sunlight passed through heat-diminishing screens (both green glass and living foliage).

After the nemas had been rayed and returned to water in a watchglass, and after they had resumed their former less active somewhat outstretched state, they were tested again and again with the infrared rays. Two observers, noting the nemas before they were removed from the watchglass of water and after they had been rayed, declared the ovijection to be stimulated, and in one case the stimulation to be very marked indeed. In this case, at the time when the nema was removed from the glass, oviposition was diminishing to almost nil, only now and then an egg being deposited,—at intervals of half a minute or thereabouts; however, after she had been rayed and returned to the water where her behavior could be observed more accurately, deposition was going on vigorously,—batches of something like twenty eggs were being ejected at intervals of five to ten seconds. It should be remembered that these two females *already had their egg-laying capacity partially exhausted* and were therefore probably less favorable specimens for experiment than if they had just issued from the ground.

The conclusions drawn from the experiments were that, without doubt, *the radiant heat from the hot steel met with instant response by the nema and that the response was very definite and that the egg deposition was very markedly stimulated by the rays.*[4]

Apart from ultra-violet, apparently very little is known about the relative *amounts* of various light frequencies that are passed through different quantities of fog and watery vapor in the atmosphere. It is known that fog and vapor are more or less impervious to ultra-violet, but pervious to many other frequencies, among them blue and a certain amount of red and infra-red. However, nobody appears to have devised a method or instrument by which the amount of any particular one of these various other frequencies penetrating *under various atmospheric conditions* can be satisfactorily measured, although there is reason to hope that such data can be established.

It is very evident, however, that during the morning under consideration, which was showery with light rain much of the time, the weather varying all the way from thick fog to almost sunny,—fog so thick that the fog-horns were blowing, and yet at times the sky toward the east such that the sunlight came through rather clearly,—it is very evident that the amount of any given spectrum frequency reaching the experiment field probably would vary during the morning nearly through the entire daylight scale, or at least much of it.

[4] But whatever stimulus, if any, the nema received from the sky was not sufficient by itself to cause any marked oviposition.

APPLICATION TO THE OVIJECTION OF *Mermis subnigrescens*.

The observations to date seem to shut out the possibility that ultra-violet has much of anything to do with ovijection taking place naturally in the open. The present observations seem *again* to make it exceedingly probable that radiant heat must have much to do with it. Recalling that the early morning light is relatively rich in red and infra-red, and that as moisture (dew, rain) is essential, or at any rate highly favorable, to the oviposition of *M. subnigrescens*, then obviously early morning and forenoon would be a favorable time of day for the oviposition. It is certain, from spectroscopic tests made during the morning in question, that *all* the time after sunrise a good deal of blue light was being passed through the atmosphere; and it therefore might have been a behavior stimulus, and no doubt was so.

All this harmonizes with previous experiments on the ovijection of this species,—an account of which is already published,— and explains the motive for the tests described above.

Thus we have a fairly complete theory of the above-ground egg-laying activities of *Mermis subnigrescens*. When the nema is ripe for labor, she moves from her pitch dark, subterranean "domicile" to the surface of the ground. Her movements during this trip no doubt exemplify apogeo-, hydro-, thermo-, rheo-, thigmo-, and finally, just before she reaches the surface, photo-tropism.

Once her head is free of the surface of the ground, her chromatrope comes into full play, "detecting" the direction and amount of light from the sky, particularly, perhaps only, blue light. The structure of the chromatrope is particularly adapted to the reception of light *from above* or *from any side*, for the light will be concentrated in the chromatrope by the transparent front tissues of the head acting as a hemispherical lens, and the side tissues acting as a cylindrical lens.

As she clambers higher and higher on the herbage, she responds to such blue sky light as is not intercepted by the green blades of grass and other foliage above and around her. Led by the blue light and the urge to deposit, she will at last reach an elevation on the herbage subject to a more direct action of the sun's rays, when the ovijector and uterine muscles will be affected by red rays and ovijection will begin; and this place in many instances would be *at the altitude of grazing grasshoppers*, the definitive hosts.

This would be a new and special parallel to the ordinary sequence of events in ovijection and parturition. In other words the "voluntary" nervous system comes first into play, bringing the organism into con-

ditions favorable to the events about to follow. Thereafter the behavior is more or less "involuntary," as has been shown in the present instance by the fact that ovijection continues under the stimulus of sunlight, even if the head, including the chromatrope and central nervous system, be removed,—seared off.

CIRCUMSTANTIAL EVIDENCE FOR THE CHROMATROPISM OF *Mermis subnigrescens*

1. The commonly infested grasshoppers graze mostly within certain limits above the ground; harmoniously, the eggs of the mermithid parasite are found to occur preponderantly within these limits, suggesting highly developed egg-laying instincts on the part of the nema that might well presuppose tropism.

2. A definite mechanism, believably a phototrope [includes chromatrope, (includes glaucotrope)] embodying what are believably receptors, transmitters, and effectors, is present;—a mechanism not otherwise readily explicable. The only mermithid individuals known to possess such a mechanism fully developed are those whose *blackish eggs are deposited in the way* characteristic of *Mermis subnigrescens*.

3. The putatively-chromatropic pigment absorbs,—i.e., can be sensitive to,—blue rays.

4. Only adult, chromatroped, egg-laying females clamber as described. Males and young females having no power, or occasion, to deposit eggs are not chromatroped.

5. The clambering of the nemas ripe for oviposition is skyward;—*i.e., toward blue sky, rather than vertical* (distinction from negative geotropism). Beams of blue light *from the sky*, often oblique, and coming from many widely different directions, are those most certain promiscuously to penetrate the depths of the herbage, and thus reach to near the ground. The nema's lens-like tissues concentrating light upon the chromatrope, accept it from above and from all sides; this harmonizes with the distribution of blue sky light.

6. Oviposition is stopped, or very much slowed, by green screens (including living foliage) that absorb red and infra-red; indicating a necessity for the nema to escape from exclusively green light before oviposition can take place. In the grasshopper habitats, blue light (sky-light) is the most diffused and most likely to be useful in leading to the known consummation, should chromatropism come into play at all. In nature, clambering skyward ("blue-ward") from out the green, brings the nema soonest under the incidence of the longer wave lengths so stimulative to the ovijectors.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE ACADEMY

222D MEETING

The 222d meeting was held in the Assembly Hall of the Cosmos Club on the evening of Thursday, October 18, 1928.

Program. Prof. WALDEMAR G. BOGORAS-TAN delivered an illustrated address on *Cultural and Scientific Work among the Primitive Tribes of Siberia.*

The so-called "lesser nationalities of the North" represent small groups of people more or less primitive, each group with a membership scarcely more than a couple of thousand or so, scattered over an immense area of tundra and forest. The whole population of these twenty-odd tribes is between one hundred and fifty and two hundred thousand. Among them are: the Chuckchee, the Koryak, the Kamchadal, the Asiatic Eskimo, the Aleut, the Yukaghir, the Chuvanzi, the Ghiliak, the Yenisseian, the Dolgan, the various branches of the Tungus and the Lamut, the Gold and the Olcha, the Orocha, the Ude of the Amur country, the Orok of the Saghalien, the Karagas and the Soyot of the Sayan Mountains. These last are the most primitive tribes among the Siberian Turki people. Here belong also the Sayomed, the Ostyak, the Vogul, and the Lapp.

Our scientific work among these tribes represented the development of the studies undertaken by the Jesup North Pacific Expedition among the Asiatic part of Circumberingian people. Thirty years ago we called these tribes "Americanoid tribes of Northeastern Siberia," but in latter years the circle of this research widened and several other groups appeared as very similar to the Northeastern Americanoids in most of the conditions of their life and culture. We call these tribes at present Proto-Asiatic, which from the point of view of an Americanist means to imply that at some stage of their early history they presented a close resemblance to the Proto-American, who, much later on, were connected with Asia in various branches of their life and culture.

When, after the War and the Revolution, we resumed our scientific work among these tribes of northern and northeastern Siberia, we had first of all to solve some very important practical problems referring to the well-being and to the very life of these tribes which until then were only an object of our scientific research. For several centuries before the War these tribes were oppressed and threatened with extermination. The Revolution and the civil disturbances brought them to utter destitution and even carried them to the brink of starvation. In order to improve this nearly castastrophic condition of things there was organized in 1924, partly on the suggestion of Waldemar Bogoras, a special "Committee for Assisting the Lesser Nationalities of the North," in abbreviation, the Northern Committee.

Among the measures introduced and carried through by the Committee may be mentioned:

1. The remission of all taxes and direct payments in the Polar districts.
2. The complete abrogation of all military service by the natives.
3. An increase of the necessary supplies and provisions imported into the northern countries and an improvement of their quality.
4. The organization of self-government and of native jurisdiction; this has led to increased self-confidence among the tribes.
5. Credits have been given to the reindeer breeders and insurance of the herds is being introduced.

6. Measures for the protection of fur-bearing animals have been introduced and are being carried through.
7. Land surveys are being undertaken to protect the territories of the natives against colonists.

A peculiar type of the so-called "cultural bases" was introduced. These bases represent special settlements arranged in the very middle of native territory at a distance from Russian settlements and villages. Three of such bases are already started. Each of them includes a hospital, a veterinary institution, a school of higher type, a coöperative store, a standard reindeer herd, and some model workshops for operating with local material. A local official center is also established there. "For the native and through the native" is the motto of the whole cultural work of the Northern Committee.

Since the northern natives bring to the State a good half of the most valuable peltries, such as sable, ermine, white and red fox, gray squirrel, etc., and since reindeer breeding, which is most important in the community life of northern Eurasia, was created and is carried on solely by northern natives, it was but fair for the Russian State in its period of new organization to spend some part of its income on improving the miserable conditions of those hard-driven stepsons of civilization.

In the matter of education, fifty schools, with free board, were arranged, having 800 pupils. (In 1926–27 there were only twenty-five schools.) A special college of higher type was established in Leningrad with 300 students, and smaller colleges in Khabarovsk, Amur country, and Irkutsk, Siberia. The Northern College of Leningrad is of special interest. It was started in 1924, with sixty students. In 1927, it had 192 students, among whom were twenty girls. The yearly expenses were $150,000. This year the number of students will be 300. The college forms at present an important section of the great Leningrad Eastern Institute. The students represent twenty-four tribes of those mentioned above. The Leningrad Eastern Institute is now embodied in the Geographical Department of the University of Leningrad, which has an ethnographical section of eight branches. About twenty-five of the young scientists in the Department pursue cultural and scientific work among the tribes of the north. Their work includes teaching and field activities among the natives. In the scientific investigations the Museum of Anthropology and Ethnography of the Academy of Sciences coöperates with the Ethnographic Section of the University. Several expeditions are organized every year for field work in Northern Siberia. The studies include problems of material and social culture, of religion, folklore and linguistics. Effective work is being done to raise the cultural level and the standards of living of the tribes. (*Author's abstract.*)

223D MEETING

The 223d meeting was under the joint auspices of the U. S. Navy Department and the Carnegie Institution of Washington, and was held in the Auditorium of the Interior Department Building on the evening of Tuesday, Dec. 4, 1928. After calling the meeting to order, Vice-President HEYL turned the chair over to the Secretary of the Navy, Hon. CURTIS D. WILBUR, who presided during the rest of the evening.

Program. Dr. F. A. VENING MEINESZ, member of the Netherlands Geodetic Commission, Professor of Geodesy at the University of Utrecht, and honorary member of the Academy, delivered an illustrated address on *Gravity Measurements at Sea and their Significance.*

Gravity at sea may be found with the necessary accuracy of 1 part in 250,000. The same pendulum method is used as has already been used satisfactorily on land; it is well known that the period of a pendulum is dependent on the value of gravity, and therefore by determining this period gravity may be deduced. Of course this method has to be adapted to meet the difficulties due to disturbance by the motion of the ship. This may be done by swinging two pendulums together in the same plane of oscillation. The horizontal movements, which cause the greatest disturbance in the pendulum motion, are thus the same for both pendulums and consequently their effect may be eliminated. By combining the movements of the two pendulums in the right way we can find a result that is free from the disturbance. The apparatus makes this combination automatically, so that the photographic records give quite regular curves, although each pendulum by itself is much disturbed. A great many other smaller disturbances have to be taken into account, but these do not present difficulties. The method can, however, only be applied if the ship's movements do not exceed a certain limit, and this makes it necessary to work in a submerged submarine; in this way the ship may descend to a depth where the wave motions are small and a sufficiently steady platform is obtained.

The purpose of gravity measurements is twofold. The first is the determination of the figure of the earth. The theory of the gravitational potential shows that this figure may be computed if gravity be known over the entire surface of the earth. It is clear that this implies the making of gravity measurements at sea, but this is the only way to determine the complete figure of the earth: the other geodetic method, that of arc measurements, can be applied only on the continents. This point is of especial importance because the results of the recent investigations tend to show that the figure of the earth is slightly irregular, deviating over extensive areas perhaps as much as 500 feet from an ellipsoid of rotation. The continental measurements alone are therefore insufficient to give the complete figure of the earth. A few cruises over the oceans would contribute an important part of what is needed. In this way gravity work at sea is of basic importance for geodetic and hydrographic work and for all map and chart making.

The second purpose of gravity investigations is to obtain data for the study of the earth's crust. From these measurements we get indications regarding the distribution of abnormal masses in the crust. These may be used for geological studies and for a study of the physical behavior of the crust. In this way the values on the continents have led to the discovery of isostasy, that is, the fact that the earth's crust is in floating equilibrium on the subcrustal layers, which though viscous have, nevertheless, enough fluid properties to allow the crust to sink into them till equilibrium is reached.

The first problem of gravity observations at sea is to learn whether this equilibrium is also present at sea. If a deviation is found, there are three possibilities. First, the gravity anomaly may be caused merely by a wrong assumption about the way in which the masses in the crust are distributed, so that the departure from equilibrium may be only apparent and not real. This can, however, never cause other than local anomalies. Secondly, it may be that the cause that has brought about the deviation from equilibrium is no longer active, and that the deviation is caused by the lag in the restoration of equilibrium due to the viscosity of the subcrustal layers. Thirdly, and most important, the departure of equilibrium may be caused by stresses working in the crust or in the subcrustal layers. These data would in this way give us a means of stating these stresses and of computing their intensity,

and thus of finding the causes of the deformations in the earth's crust. The following problems in connection with gravity work at sea may be indicated; the list however is not meant to be exhaustive.

Gravity over the open oceans. The few observations now available seem to show that, although roughly speaking isostasy is present, there are extensive though not very considerable excesses of gravity in the Atlantic and the Pacific Ocean. It would be important to investigate this further in order to see whether these results are confirmed elsewhere and whether their distribution shows a general relation to the distribution of sea and land on the earth's surface, as now appears to be the case.

Gravity along the continental shelf. On this question the voyage of the U. S. S. S-21 has given valuable data. The results obtained along the shelf between the West Indies and Cape Hatteras show, as far as can be seen from the provisional results, the same curious anomaly that has been found also on the Pacific Coast of Central and North America: an excess along the foot of the slope. An interpretation of this result must wait till the figures are accurately known and can be studied.

The investigation of inland seas. Here also the expedition brings back an increase of knowledge: a series of observations have been made over the Mexican Gulf, which show a remarkable excess of gravity. The Mississippi delta had been investigated by means of two profiles of stations running up to the coast, but apparently there is no evidence that this delta is playing any rôle in this departure from equilibrium.

The investigation of ocean deeps. These deeps are suspected to be recent deformations of the earth's crust where stresses are probably still present: the earthquakes in these regions confirm this supposition. A great many detailed data were gathered during the expedition regarding two of these deeps: the Bartlett deep south of East Cuba and the Nares deep north of Porto Rico. The results fully agree with the expectations. The latter deep especially shows big departures from equilibrium, and a detailed study of the final results will help to understand the deforming stresses which are acting there. It may be added that gravity observations north of Haiti and north of East Cuba show that these stresses continue much further westward than the deep itself would indicate.

Much credit is due the authorities of the U. S. Navy and the Carnegie Institution of Washington for undertaking this scientific investigation and organizing this expedition, and to the commander of the U. S. S. S-21, Lieut. J. L. Fisher, who by ordering all the submergences necessary for the measurements made it possible to get the numerous results which were brought back, and to the helpful assistance given during the whole voyage by the officers, Lts. Hall, Hamblin and Sodergren, and by the crew. The great number of submergences, 49 in all, of which there were often several in one day, were an additional strain on everybody. (*Author's abstract.*)

Dr. F. E. Wright of the Geophysical Laboratory of the Carnegie Institution delivered an illustrated address on *The Trip of the U. S. S. S-21.*

The recent 7000-mile cruise of the U. S. S. S-21, Lt. J. L. Fisher commanding, over the Gulf of Mexico and the Caribbean Sea for the purpose of measuring gravity at selected points was remarkably successful. At no time during the voyage was there trouble with the operation of the submarine or with the gravity-measuring apparatus. This bespeaks capable officers and an efficient crew to maintain in good working order the mass of complex machinery that is crowded into a submarine. During the cruise 46 gravity stations at sea were occupied. Measurements were made over the Bartlett Deep,

the Nares Deep, the Mississippi delta, the continental shelf and certain extended portions of the Gulf of Mexico, the Caribbean Sea, and the Atlantic Ocean. The isostatic gravity anomalies deduced from these measurements through the active coöperation of the U. S. Coast and Geodetic Survey indicate that the Nares Deep is an uncompensated geologic feature in which shearing stresses of large magnitude are present in the earth's crust; likewise the eastern part of the Bartlett Deep and Virgin Island Deep. The Mississippi delta is practically compensated in spite of the fact that each year a load exceeding one twentieth of a cubic mile of sediment or nearly 12 billion tons is being laid down. On the other hand large positive anomalies over the deeper portions of the Gulf of Mexico, the Caribbean Sea, and the Atlantic Ocean indicate a condition for which a satisfactory explanation has not yet been found. The same condition obtains over the Pacific Ocean in so far as measurements have there been made.

Life aboard a submarine was described briefly; incidents of the voyage were illustrated by lantern slides. Notwithstanding the discomforts that necessarily exist in a submarine because of limited quarters the crew and officers of the submarine at no time complained, but were always ready and eager to aid the scientific work whenever possible and to dive at any time of day or night. The efficiency of the Navy in undertaking a project of this nature and carrying it through without a hitch formed a most impressive exhibit of preparedness for any emergency. (*Author's abstract.*)

After their addresses the speakers answered various questions by the presiding officer and members of the audience.

WALTER D. LAMBERT, *Recording Secretary.*

SCIENTIFIC NOTES AND NEWS

A comparison of the electrical conductivity of copper and aluminum is of special interest at the present time when they happen to be selling at the same price, 24 cents a pound. The same weight of aluminum, in this case the same money's worth, will offer twice the electrical conductivity for the same length, or for wire of the same diameter the aluminum wire will be 3.3 times as long as the copper wire, although in this case its conductivity per unit of length will be only 61 per cent of that of copper.

VICTOR C. HEIKES, long engaged in work on mineral resources in Salt Lake City, has been placed in charge of the Mineral Statistics Division of the San Francisco office of the Bureau of Mines, formerly under the direction of JAMES M. HILL, now resigned.

E. P. KILLIP, Associate Curator, United States National Herbarium, A. O. SMITH, and W. J. DENNIS left Washington March 25th for botanical exploration of northern Peru and the upper Amazon. They expect to be gone about 7 months.

The United States Geological Survey celebrated its 50th anniversary on March 21, just half a century after the appointment of its first Director, CLARENCE KING. The President of the United States, who began his geologic career thirty-five years ago as a field assistant on the Survey, received the members of its staff at the White House, and then joined them for a group picture on the lawn. Later Mrs. HOOVER received the group in the East

Room, and welcomed them as fellow geologists because of her own training in that subject. In the afternoon addresses celebrating the occasion were given at the National Museum auditorium by the Secretary of the Interior, RAY LYMAN WILBUR, H. FOSTER BAIN, formerly Director of the Bureau of Mines and now Secretary of the American Institute of Mining and Metallurgical Engineers, ARTHUR E. MORGAN, President of Antioch College, HENRY FAIRFIELD OSBORN, President of the American Museum of Natural History, ARTHUR L. DAY, Director of the Geophysical Laboratory, and JOHN C. MERRIAM, President, Carnegie Institute of Washington. In the evening nearly 600 members and friends of the Survey gathered at a banquet in the Hotel Washington; the program included several brief speeches and playlets and ended with a dance. Many of the former geologists and other scientific men of the Survey were present, including H. F. BAIN, MYRON L. FULLER, E. W. PARKER, WALLACE W. ATWOOD, GEORGE H. ASHLEY, K. C. HEALD, and M. O. LEIGHTON.

E. F. BURCHARD, Geologist, will be on leave from the Geological Survey for two months to engage in commercial work in South America.

FRANK REEVES and C. P. ROSS, of the U. S. Geological Survey, have returned from two months work on the Panama Canal Zone, where they examined the proposed Alhajuela dam and reservoir sites for the Panama Canal.

ROBERT RIDGWAY, curator of the division of birds in the U. S. National Museum since 1876, died on March 25, in his seventy-ninth year.

The Emeritus Professors of the George Washington University were entertained at a luncheon in their honor by the President of the University, Dr. CLOYD HECK MARVIN, on March 26, at the Cosmos Club. Included in the company were the following distinguished men of science: JAMES HOWARD GORE, mathematician and astronomer, who has represented the United States at numerous scientific congresses abroad and who has been decorated by eight foreign countries; HARRY CRECY YARROW, formerly curator of the Division of Reptiles of the United States National Museum, for thirty years Acting Assistant Surgeon of the United States Army; DANIEL KERFOOT SHUTE, ex-president of the Medical Society of the District and of the Society of Opthalmologists and Otologists of Washington; WILLIAM KENNEDY BUTLER, physician; CHARLES EDWARD MUNROE, inventor of smokeless powder, Chief Explosives Chemist of the United States Bureau of Mines; CHARLES WILLIAMSON RICHARDSON, ex-president of the Medical Society of the District; GEORGE PERKINS MERRILL, Curator of the Department of Geology of the United States National Museum; STIRLING RUFFIN, physician.

The tenth annual meetings of the AMERICAN GEOPHYSICAL UNION and of its sections will be held in the National Academy and Research Council Building, Washington, D. C., April 25 and 26, 1929. Following the business meeting of the General Assembly of the Union on the afternoon of April 26, the Union will hear the five following general-interest papers presented by the Section of Oceanography; these all concern work in progress or recently completed: *The expedition of the submarine S-21 to the Caribbean Sea and*

Gulf of Mexico, by C. S. FREEMAN; *Oceanography and the fisheries*, by HENRY B. BIGELOW; *The international ice patrol, with special reference to its economic aspects*, by EDWARD H. SMITH; *The coöperative survey of the Great Lakes*, by CHARLES J. FISH; *The work of the* CARNEGIE *to date*, by W. J. PETERS.

The meetings of the six sections will be held on the mornings of April 25 and 26 and the afternoon of April 25. For each Section short business meetings will be followed immediately by progress-reports and scientific papers. The Section of Geodesy (morning April 25) will be devoted to progress-reports and recent developments in gravity and geodetic work in Mexico, Canada, and the United States as follows: *Gravity-work in Mexico during the past year*, by PEDRO C. SANCHEZ; *Gravity-comparisons in Europe and America*, by A. H. MILLER; *The measurement of gravity at sea*, by F. E. WRIGHT; *Recent developments in time-service methods*, by C. B. WATTS; *Recent developments in geodetic instruments*, by D. L. PARKHURST; *Geodetic work in Canada during the past year*, by NOEL OGILVIE; *Geodetic computations and investigations*, by H. G. AVERS; *Accomplishments in field geodesy during the year April, 1928, to April, 1929*, by WILLIAM BOWIE. The Section of Terrestrial Magnetism and Electricity (morning April 25) will hear a symposium on physical theories of magnetic and electric phenomena including the following papers: *The corpuscular-ray theory of aurora*, by N. H. HECK; *The ultraviolet-light theory of aurora and magnetic storms*, by E. O. HULBURT; *The atmospheric dynamo-theory of variations in earth-currents and terrestrial magnetism—a review*, by O. H. GISH; *A tentative theory of the permanent magnetic field of the sun and earth*, by ROSS GUNN; *Echo-sounding of the Kennelly-Heaviside layer*, by M. A. TUVE.

The Section of Oceanography (afternoon April 25) will hear the following communications: *Oceanography and meteorology*, by CHARLES F. BROOKS; *Oceanography and littoral geology*, by DOUGLAS W. JOHNSON; *The significance of plankton-investigations*, by CHARLES J. FISH; *Oceanographic observations in Monterey Bay, California*, by HENRY B. BIGELOW; *Recent work on the dynamic oceanography of the North Atlantic*, by C. O. ISELIN; *Echo-sounding*, by W. E. PARKER. Additional oceanographic papers of general interest in this vast field will be presented as indicated above at the General Assembly on the afternoon of the following day. The Section of Volcanology (afternoon April 25) will hear and discuss the following papers: *Volcanic oceanic islands*, by H. S. WASHINGTON; *Volcanoes of Java and Bali*, by E. G. ZIES; *The volcanic history of the San Juan Mountains, Colorado*, by E. S. LARSEN; *Recent eruptions of Kilauea*, by T. A. JAGGAR.

The Sections of Meteorology and Seismology will hold meetings on the morning of April 26. The first will be devoted to the *Report of the meteorological division of the Committee on the Physics of the Earth*, which will include the following: *Introduction*, by H. H. KIMBALL; *The origin and composition of the atmosphere*, by W. J. HUMPHREYS; *Meteorological data and meteorological changes*, by C. F. MARVIN and A. J. HENRY; *Solar radiation and its rôle*, by H. H. KIMBALL; *Meteorology of the free atmosphere*, by W. R. GREGG; *Dynamic meteorology*, by EDGAR W. WOOLARD and HURD C. WILLETT; *Physical basis of weather forecasting*, by CARL-GUSTAF ROSSBY and RICHARD H. WEIGHTMAN. The scientific program of the Section of Seismology will include: *Surface-waves*, by J. B. MACELWANE; *Forces and movements at the earthquake-origin*, by H. F. REID; *The velocity of surface-waves*, by F. NEUMANN; *The seismicity of the arctic as indicated by instrumental data*, by E. A. HODGSON; *Earth-vibrations from dynamite blasts*, by L. D. LEET.

The scientific sessions are open to persons interested in geophysics, whether members of the Union or not, and all such are cordially invited to attend. These annual meetings are increasingly interesting each year, not only because of the stimulus afforded the study of problems concerned with geophysics but also by reason of the coöperation of the corresponding geophysical organizations of Canada and Mexico which is making for initiation and coördination of geophysical researches depending upon international and national coöperation.

JNO. A. FLEMING, *General Secretary.*

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BOTANY.—*Botanical notes on, and descriptions of, new and old species of Venezuelan plants.*[1] H. PITTIER, Caracas, Venezuela.

In the course of my systematic work on different groups of the Venezuelan flora, I often have had the opportunity to come across old species which had been incompletely described, or the identification of which by former botanists is subject to criticism. Also I have met with new species which did not enter into the field of my other publications. In the present article, I have brought together some of these descriptions and notes.

MIMOSA TOMENTOSA Humb. & Bonpl. in Willd. Sp. Pl. 4: 1033. 1799.

Fruticulus inermis, erectus, ramulosus, ramis ramulisque teretibus, adpresse hirsutis; stipulis subulatis, villosis, persistentibus; foliis bipinnatis, petiolatis, pinnis bijugis, jugis valde approximatis, petiolo communi rhachidibusque longe subulato-mucronatis dense hirsutis; foliolis 8–15(–18)-jugis, subsessilibus, trinerviis, subfalcatis, oblongis, basi inaequalibus dimidiato-cordatis, apice rotundatis apiculatis mucronatisve, supra subtusque adpresse-villosulis, marginibus ciliatis; capitulis ovatis ad apicem ramulorum axillaribus, solitariis, pedunculatis, pedunculis villoso-pubescentibus; floribus carneis, sessilibus, densissimis, bracteolatis, bracteolis spathulatis, elliptico-lanceolatis, longe ciliatis, floribus brevioribus; calyce tubuloso, quadrifido, scarioso, tubo glabro, laciniis longissime fimbriatis; corolla tubulosa, apice paulo latiora, lobulis 4, oblongis, apice pubescentibus; staminibus 4, longe exsertis, glabris, antheris ovoideis, dorsifixis; ovario 2–3-ovulato, brevissime stipitato, oblongo-ovoideo, villoso; stylo filiformi, glabro; legumine oblongo, villoso, vulgo dispermo, basi stipitato, apice breviter mucronato, inter seminibus contracto, articulis 2 solubilibus.

Fruticulus 15–30 cm. altus. Stipulae 3–7 (6.4–6.8) mm. longae. Petioli 0.7–2 (1.3–1.8) cm. longi; pinnae 2–3 (5.8–7.3 cm.) cm. longae; foliola 5–11 (8.5–11) mm. longa, 2–2.5 (3–3.8) mm. lata. Capitula circa 1 (1) cm. longa; pedunculi 1.5–2.5 (1.7–2) cm. longi. Bracteae 2 mm. longae. Calyx 1–1.5 mm. longus. Corolla 2.5–3 mm. longa. Pistillum 4–5 mm. longum. Legumen 2 cm. longum, 0.6 cm. latum.

[1] Received March 22, 1929.

Banks of the Orinoco near Maypures, Atures y Carichana; flowers May (*Humboldt & Bonpland*, type); Barcelona, Anzoátegui (*Moritz*); between El Becerro and Orituco River, llanos of Guárico, in small savannas of gallery-woods; flowers and fruits April 15, 1927 (*Pittier* 12359).

With the exception of slight differences, insignificant on the whole, this description agrees with that of the Genera and Species,[2] the only serious discrepancy being in the length of the pinnae. It is therefore likely that our plant is identical with that partially described by Kunth, this so much the more since the measurements of the pods, obtained by Bentham from the specimens collected by Moritz, are almost exactly the same as the ones given above. In our specimens I found in the indument of the terminal parts numerous transparent granules, free and probably of the nature of a resin; they are doubtlessly secreted by the plant itself.

Emelista mucronulosa Pittier, sp. nov.

Suffruticosa, caulis in aetate glabrescentibus ramulisque praeter angulosis rufo-villosis; stipulis linearibus apiculatis, ciliato-villosis, persistentibus; foliis 2–3-jugis petiolis brevibus villosis, foliolis brevissime petiolulatis, ovalibus vel plerumque obovatis, basi subaequalibus rotundatis, apice late rotundatis molliter mucronulatis, marginibus rufo-ciliatis, pilis adpressis, supra praeter nervibus adpresse-villosis subtus parce villosulis, inferioribus minoribus; glandulis tenuibus fusiformibus inter paria inferiora 1–2; pedunculis communibus brevibus, 1–3 floribus pedicellisque dense rufo-villosis; bracteis longis, setaceis, villosis, caducis; floribus parvis; sepalis 5, ovalibus, inaequalibus, duobus exterioribus minoribus subacutis, alteris obtusis, interior major, omnibus praeter basin rufo-villosis, marginibus plus minusve ciliatis; petalis 5, glaberrimis, leviter inaequalibus, ovatis obovatisve, basi in unguem brevem contractis; staminibus 7, 3 majoribus inter se inaequalibus, 4 minoribus, apice obtuso, breviter contracto; staminodiis 3, parvis, filamentis crassis, antheris distincte evolutis; ovario sessili, dense villoso; ovulis 5–10; stylo glabro, valde arcuato, stigmate incrassato, truncato; legumine tereto, recto, rufo-hirsuto, inter semina contracto, marginibus prominentibus; seminibus 5–9, longitudinalibus, oblongo-obtusis.

Suffrutex 30–60 cm. altus. Stipulae 0.7–1 cm. longae. Petioli communi 3.5–5 cm. longi; petioluli 1–2 mm. longi; foliola 2.5–4 cm. longa, 1.2–2.5 cm. lata; glandulae circiter 1.5 mm. longae. Pedunculi communi 0.5–0.8 cm. longi; pedicelli brevissimi. Bracteae 1–1.5 cm. longae. Sepala 3.5–5 cm. longa, 1.5–3 mm. lata. Petala 3.5–4.2 mm. longa, 1.9–2.5 mm. lata. Filamenta 0.5–1.4 mm. longa; antherae 1.7–2.7 mm. longae. Legumen 2–4 cm. lngum, 3–4 mm. latum; semina 4 mm. longa.

LARA: Vicinity of Barquisimeto; flowers and fruits July, 1925 (*J. Saer d'Héguert* 282, TYPE).

Belongs to the group of *Emelista Tora* (L.) Britt. & Rose, *E. pilifera* Pittier (*Cassia pilifera* Vog.) and *E. mucronifera* Pittier (*Cassia mucronifera* Mart.), being easily distinguished from them by the diminutive size of the flowers and the shortness and structure of the pods. It differs, also, from the first in the villous sepals, the shape of the staminodes and the indumentation

[2] H. B. K. Nov. Gen. & Sp. 6: 253. 1823.

of the pod and leaves; from the second in the number of the leaflets, the petaloid sepals hairy at the base, and in the length of the clawlets of the petals, and from the third in the number of the leaflets, the general indumentation and the length of the pedicels. The shape, dimensions and dehiscence of the pods make it doubtful as to whether I am justified in placing this species in genus *Emelista;* possibly it should come somewhere in sect. *Chamaesenna* of the complex genus *Cassia.*

Peiranisia mutisiana (Kunth) Pittier

Cassia mutisiana Kunth, Mimoses 142. *pl. 43.* 1819.

Fruticosa, ramulis sublignosis, 4-angulatis, angulis prominentibus molliter setaceo-hispidissimis demum fulvo-pubescentibus; stipulis lineari-acuminatis, hirtellis; foliis plus minusve arcuatis, paripinnatis, rhachi flavescenti-villoso; foliolis 30–36-jugis, brevissime petiolulatis, crassis, oblongis, basi oblique rotundatis, apice rotundatis, fere breviter molliterque mucronulatis, supra glabris papillosisque, subtus nervo prominente parcissime villosula excepto glabris, marginibus incrassatis, petiolulis glabris; glandulis inter omnia paria, 1–3 inferioribus majoribus, crassioribus, subclavatis, erectis, reliquiis fusiformibus, acutis, oblique insidentibus, parce hirtellis; racemis in apice ramulorum axillaribus solitariis, 4–7-floribus; pedunculo anguloso pedicellisque flavescenti-hirtellis, bracteis nullis evanescentibusve, interdum glandula crassa, clavata ad pedicellorum basin; sepalis 5, valde inaequalibus, petaloideis, ovalibus, suborbiculatisve, 3 exterioribus minoribus, ciliatis, extus basi villosulis, 2 interioribus majoribus glaberrimis; petalis 5, inaequalibus sepalis duplo vel triplo longioribus, ovatis, obovatis suborbicularibusve, glaberrimis, flavis; staminibus 7, subaequantibus, filamentis crassis, antheris 4-sulcatis, 4 superioribus breviter rostratis, 3 inferioribus obtusis, biporosis; staminodiis 3, filamentis staminum subaequantibus, applanatis, subclavatis, apice bilobulatis; ovario stipitato, lineari, styloque arcuato, stipite adpresse villosulo, reliquis glabris glabrescentibusve.

Folia 7–8 cm. longa; foliola 6–10.5 mm. longa, 2–3 mm. lata. Stipulae 1–1.2 cm. longae. Pedunculi ad 2.5 cm., pedicelli ad 1.5 cm. longi. Sepala 4–10 mm. longa, 3–9 mm. lata. Petala 12–18 mm. longa, 7.5–14 mm. lata. Filamenta 1–2 mm. longa; antherae 4–5.5 mm. longae.

MÉRIDA: Quirorá, 2000 m. (*Dr. A. Jahn* 692).

Notwithstanding small discrepancies, I think there should be no hesitation in identifying Dr. Jahn's plant with the one described by Kunth under the name of *Cassia mutisiana.*

MYROSPERMUM FRUTESCENS Jacq. Enum. Pl. Carib. 20. 1760.

A tree well distributed in the hot dry belt along the Caribbean coast, between the Colombian city of Cartagena and the island of Trinidad. In Venezuela, where it is apparently more abundant and better known, it penetrates far inland, accompanying the thorn forests which surround the Llanos. Though fairly constant in its fundamental characters, it is very variable in the secondary ones and Klotzsch[3] thought it possible to subdivide it into at least three species, one of which, besides the typical one, belonged to Venezuela.

[3] Bonplandia 5: 276.

My protracted acquaintance with this tree does not so far support the views of the celebrated German systematist, views which, anyhow, have not been generally accepted. With reference to the petioles, they should be glabrous in *M. frutescens*, but according to my observations, they are so only in age, and on the same branchlet some are very glabrous and others tomentose-pubescent. In the size of the leaflets there is some variation, which is perhaps constant for each individual tree, the smaller leaflets being found mostly on the larger ones; the indumentum of the inflorescences is very variable, often only puberulent on specimens which otherwise would be considered as *M. frutescens* and obviously pubescent in others of the *M. secundum* type. The indumentum of the ovary is variable in the same way and no true differential character can be drawn from the variable size of the pods. Furthermore all forms of the tree which came under observation were deciduous, and the flowers always appeared before the leaves, with the exception of some accidental late flowering. There does not seem to exist between the very variable size of the tree and others characters any correlation such as Klotzsch attempted to establish. The same will probably prove true of his *M. emarginatum*. It is therefore reasonable that this and *M. secundum* should have been relegated to synonymy under *M. frutescens* Jacq., the genus being monotypic.

DIPHYSA SENNOIDES Benth. Nat. For. Kjöbenh. Vidensk. Medd. **1853:** 12. 1854.

The type of this species is from Vera Cruz, Mexico. It is described as having from 11 to 25 oblong or oval-elliptic and mucronulate leaflets; the floral racemes bear from 2 to 5 flowers, the pedicels of which are hardly longer than the calyx; the stipe of the pod is said to be longer than the calyx; and the vesicles are ribless. According to Standley, this shrub reaches 3 to 4 meters, the leaflets are about 13, the fruit is about 10 cm. long.

The Venezuelan specimens have from 11 to 25 leaflets, which agrees with Bentham's description; they are sparsely pubescent underneath and measure from 4 to 10 mm. in length, with a width of from 2.5 to 4 mm. The pedicels are much longer than the calyx, measuring from 12 to 15 mm., while the latter does not exceed 8 to 9 mm. The fruits on our specimens, moreover, are much shorter than indicated by Standley, their length varying from 2.5 to 5 cm.

The descriptions published thus far are very summary and it is to be expected that, on more thorough investigation, the Mexican and Venezuelan plants will be found to be specifically distinct.

Geranium meridense Pittier, sp. nov. (Sec. 28. *Laxicaulia* R. Knuth.)

Planta probabiliter perennis, decumbens, rhizomate (?), caulibus ad nodos inferiores radicantibus, elongatis, tenuibus, pilis minutis, retrorsis parcissime puberulis; ramulis axillaribus, adscendentibus suberectisve, angulosis, hirtellis pilis retrorsis; stipulis lanceolatis, scariosis, ciliatis, persistentibus; foliis basalibis (?) caulinis petiolatis, firmis, in sicco fragilibus; petiolis angulosis, canaliculatis, hispidis; laminis subtus pallidioribus utrinque pilis albis adpressis obsitis, ambitu 5-angulatis usque ad 3/4–2/3 regulariter palmato-5-partita, lobulis 3 interioribus 3-dentatis, dentibus acutis dentibus lateralibus brevissimis, lobulis exterioribus saepe 2-dentatis; pedunculis tenuibus plerumque bifloris, retrohispidis; pedicellis primum deflexis tenuioribus, tomentoso-hispidis apicem versus copiose glandulosis;

bracteis minutis, lanceolato-acutis, basi longe ciliatis; sepalis ovalibus, trinerviis, mucronatis, nervibus extus marginibusque dense glanduloso-pilosis; petalis roseis, late ovatis (interdum suborbicularibus), breviter unguiculatis, basi rotundatis, apice subemarginatis, sepalis brevioribus; staminibus petalis brevioribus; staminibus petalis brevioribus, filamentis ciliatis; fructus adpresse villosus, stigmatibus persistentibus glabratis.

Caules 20–35 cm. longi, internodiis 3.5–6.5 cm. Stipulae 2–5 mm. longae. Petioli 0.5–2.5 cm. longi; laminae 0.6–1.3 cm. longae, 0.6–2 cm. latae. Pedunculi 3–6 mm. longi (fructiferi usque ad 2.5 cm. longi); pedicelli 1–3 mm. longi (fructiferi 1–2 cm.). Bracteae 1–2 mm. longae. Sepala circa 5 mm. longa, 2–2.5 mm. lata (mucronum 0.3–0.4 mm.); petala 3–3.4 mm. longa, 2–3 mm. lata, unguiculo 0.2–0.3 mm. longo. Filamenta 1.8–2.5 mm. longa. Fructus (vix maturus) circa 1 cm. longus.

MÉRIDA: Páramos de Sto. Domingo and Chachopo, 3100 m., flowers Sept. 14, 1922 (*Dr. A. Jahn* 1130a, TYPE).

A careful study of Dr. Jahn's specimens led me to the conclusion that not only are they distinct from *G. diffusum* H. B. K., with which they had been identified, but that they do not even belong to the same section. I would place this species with the *Laxicaulia*, its closest affinities being with *G. elongatum* R. Knuth. *G. diffusum* is known so far to extend from Peru to Ecuador along the Pacific watershed and its presence in Venezuela is doubtful.

Geranium chamaense Pittier, sp. nov.

Perenne, rhizomate tenuo, caulibus erectis brevibus, pilis adpressis pubescentibus; stipulis lanceolatis, apiculatis, scariosis, fulvo-brunneis, pubescentibus; foliis parvis, basalibus quam caulinis longiore petiolatis; petiolis tenuibus, minute retro-pubescentibus, laminis ambitu plus minusve reniformibus, supra minute adpresse-pubescentibus, subtus pallidioribus praecipue ad nervos hirtello-pubescentibus, usque ad 3/4–4/5 longitudine sua regulariter palmato-5-partita, lobulis 3 interioribus 3-dentatis, exterioribus profunde 2-fidis, dentibus ovalibus, acutis, apice mucronulatis; pedunculis axillaribus, solitariis, unifloribus, erectis, ebracteolatis, retro-pubescentibus petiolis longioribus; bracteis stipulis simillimis, persistentibus; sepalis ovalibus, longe mucronatis, adpresse-pubescentibus basi marginibusque longe pilosis; petalis roseis obovatis, basi breviter unguiculatis, apice rotundatis emarginatisve, sepalis paullo superantibus; staminibus petalis duplo brevioribus, filamentis ad 2/3 longitudinis sui alatis, demum nudis, alis ciliatis apice hastatis; ovario brevi, densiuscule cano-pubescente, stigmatibus glaberrimis; fructo brevi, adpresse-pubescente.

Caules 10–15 cm. longis; internodiis circa 1.5 cm. Stipulae 3–4 mm. longae. Petioli 0.5–2.5 cm. longi; laminae 1.4–1.8 cm. diam., lobuli usque ad 1 cm. longi. Pedunculi 1–2.5 cm. longi (fructiferi longiores). Sepala 4.2–4.5 mm. longa, 1.6–2.3 mm. lata. Petala 4.5–4.8 mm. longa, 1 1–2 mm. lata Filamenta 1.8–2.5 mm. longa. Fructus circa 1 cm. longus.

MÉRIDA: Páramo de los Apartaderos, upper Chama Valley, 3300 m.; flowers and fruits September 4, 1921 (*Dr. A. Jahn* 549, TYPE).

This species, I believe, should be placed among those of Sect. 16, *Rupicola* R. Knuth, near *G. hirtum* Willd., from which, however, it is distinguished by its single stems with short internodes, very small leaves, short petals, and above all by the peculiar appearance of the filaments.

GERANIUM MULTICEPS Turcz. in Bull. Soc. Nat. Mosc. 31. 1: 417. 1858.
(?) *Geranium velutinum* Turcz. ibid.

Among the *Gerania* collected in the Andes by Dr. A. Jahn, several agree with Turczaninow's description of his *Geranium velutinum.* But that description, as well as that of *G. multiceps,* also described by him, but completed to a certain degree by R. Knuth,[4] is somewhat vague. A careful examination of the specimens at hand has led me to the conclusion that they are simply incompletely developed individuals of *G. multiceps.* Only a comparison between the type specimens could show definitely whether my contention is right. Following are some measurements taken in dissecting flowers of *G. multiceps* and the alleged *G. velutinum.*

	G. multiceps	*G. velutinum*
Sepals	8.7–8.9 mm. long	7–7.5 mm. long
	2.4–2.5 " broad	2–2.8 " broad
Petals	11.2 " long	11.3 " long
	3–7 " broad	2.3–4 " broad
Filamenta	3.5–5.1 " long	5.1–5.8 " long

In 1916, Mr. Paul C. Standley[5] attributed Jahn's no. 5 to *G. velutinum,* but in 1924, Dr. S. F. Blake made it the type of his *G. sebosum,*[6] which differs from *G. multiceps* in its glandular pedicels. A specimen collected at the Páramo de Mucuchíes in December 1927, by the geologist Dr. A. Gutzwiller, corresponds to Dr. Blake's description of the new species.

GERANIUM COLOMBIANUM R. Knuth in Engler, Pflznrch. 4^{129}: 212. 1912.

The name of this species, to which I referred my no. 12969, is unfortunate both because there is already a *G. columbinum,* almost homonymic, and because the type locality, Páramo de Mucuchíes, is not in Colombia, but in the Venezuelan State of Mérida. It is doubtful whether Moritz, in his Andean wanderings, ever reached the Colombian territory. The latter remark applies to *G. Kerberi,* collected at Páramo de La Culata, Mérida, in a locality not far distant from Páramo de Mucuchíes.

TRICHILIA TRIFOLIA L. Syst. Nat. ed. 10. 2: 1020. 1759.

Arbor parva vel arbuscula, ramis brevibus, ramulis crassis vel interdum gracilibus cortice cinereo-brunnescente plus minusve ruguloso tectis; foliis petiolatis, 3-foliolatis, ad apicem ramulorum congestis; petiolo tenui, canaliculato, glabrato vel interdum argute puberulo; foliolis glaberrimis, terminali obovato, basi longe cuneato, modice petiolulato, apice obtuso vel rotundato, lateralibus minoribus breviuscule petiolulatis sessilibusve, supra laete viridibus, subtus pallidioribus, costa venisque prominulis; inflorescentiis petiolis brevioribus, pedunculatis, 3–6-floribus, umbellulatis; pedunculo glabro; floribus breviuscule pedicellatis, glaberrimis, pedicellis basi bractea oblonga minute suffultis; calyce tubuloso-campanulato, apice irregulariter 5-crenato; petalis 4–5, albis, oblongis, basin versus attenuatis, apice rotundatis; stamini-

[4] Engler, Pflanzenreich 4^{129}: 105. 1912.
[5] Contr. U. S. Nat. Herb. 19: 111. 1916.
[6] Contr. U. S. Nat. Herb. 20: 526. 1924.

bus petalis aequantibus vel leviter superantibus, filamentorum pars tertia inferiora coalitis, pars superiora lata, apice bifida, intus villoso-tomentosa; antheris 10, elliptico-ovoideis, luteis, inter filamentorum apiculis insertis; disco subtubuloso, carnoso, basin tubo stamineo connato, apice crenulato; ovario glabro in stylo breve attenuato, stigma capitellato; capsula pedicellata, globosa, matura leviter 3-sulcata, parce minuteque pilosula, densissime albo-punctulata, dehiscente, 3-valvata; seminibus plerumque 2–3, intus angulosis, extus rotundatis.

Arbor 2–7-metralis, decidua. Folia 3–9 cm. longa, petiolo 0.8–3 cm. longo; foliolum terminale 2.5–6 cm. longum, 1.2–3.5 cm. latum, petiolulo 0.6–6 mm. longo suffultum; foliola lateralis 1–4 cm. longa, 0.8–2.5 cm. lata, petiolulo nulo vel vix 0.5– mm. longo. Pedunculi 0.5–1.5 cm. longi; pedicelli usque ad 1 mm. longi. Calyx 2.9 mm. longus. Petala 4.5 mm. longa, 1.3–1.4 mm. lata. Stamina 3.5–4 mm. longa (tubo 1–1.4 mm. longo). Discus 0.7–1 mm. altus. Pistillum 2 mm. longum. Capsula circiter 6 mm. longa; semina 4 mm. longa.

CARABOBO: Vicinity of Puerto Cabello, in bushes not far from the sea-beach; flowers June 18, 1920 (*Pittier* 8903); El Carenero, Miranda, on hills around the village; fruits March 6, 1923 (*Pittier* 11014); port of El Jabillal near El Carenero, in shady places; fruits March 6, 1923 (*Pittier* 11023).

Our plant is without any doubt identical with the one collected by Loefling, as described by Linnaeus, and also by Jacquin[7] from his own specimens, but it is by no means certain that it is the species described by de Candolle.[8] All the measurements given by the latter are very much under those obtained by me from several flowers. Also I always found 10 stamens and a glabrous ovary. My description agrees with that of Jacquin, especially in the details of the capsule and of the seeds, and it does not differ much from that by Humboldt, Bonpland & Kunth.[9] It seems probable that the specimens collected by Moritz, which were described by de Candolle, belongs rather to my *Trichilia palmetorum*, described elsewhere.[10]

Abutilon cuspidatum Pittier, sp. nov.

Frutex vel arbuscula e basi ramosissima, ramis lignosis, erectis, teretibus, apice versus petiolis, pedunculisque stellato-tomentosis rufescentibus, tomento pilis tenuissimis elongatis intermixto; foliis modice petiolatis, petiolo tereto, laminis ovato-orbicularibus, 9 nerviis, basi profunde cordatis lobis arcte se tegentibus, apice longe gradatimque cuspidatis, marginibus regulariter sinuato-dentatis, denticulis grosse mucronatis; stipulis lineari-subulatis, pilosis, caducissimis; pedunculis ad apicem ramulorum axillarium dispositis, teretibus, 4–12 floribus; pedicellis villosis, tenuibus; floribus erectis plus minusve umbellatim dispositis; calyce campanulato, extus subanguloso, angulis carinatis pilis longioribus patentibus vestitis intus circum carpidiis villoso, et caetera tomentello, infra medium in lobulos ovato-lanceolatis, acuminatis, tomentellis, marginibus ciliatis diviso; petalis erectis, late cuneatis, aurantiacis, venis parallelis creberrimis saturatis percursis basi minute

[7] Stirp. Amer. 129. *pl. 82*. 1788.
[8] Monogr. Phan. **1**: 709. 1878.
[9] Nov. Gen. & Sp. **5**: 217. 1821.
[10] Arboles y arbust. nuevos Venezuela, decades 9, 10. In press.

villosis, demum glabris; androceo calyce breviore, glabro; ovario globoso; carpidiis circa 18, molliter villosis, 3-ovulatis, maturis dorso apiceque echinulatis, villosis, lateribus laevibus; seminibus 2 evolutis, rariformibus vel oblique pyriformibus, minutissime hirtellis.

Frutex 3–4 m. altus. Petioli 4–6.5 cm. longi; laminae 14–16 cm. longae, 9–10.5 cm. latae. Pedunculi 7–11 cm., pedicelli 0.8–1.6 cm. longi. Calyx 1.3–2 cm. longus; tubo 0.5–0.7 cm. longo, lobulis 0.8–1.3 cm. longis, basi 0.4–0.6 latis. Petalá 11 mm. longa, basi 4.5 mm., apice 9 mm. lata. Ovarium 4 mm. diam. Carpidia matura 8 mm. longa, 3.5 mm. lata. Semina circa 2 mm. longa, 1.5 mm. lata.

MÉRIDA: Between La Vega and San Juan, 900 m. above sea-level, in the Chama Valley, flowers Jan. 29, 1928 (*Pittier* 12760, TYPE).

On account of its 3-ovulate carpids, with two developed seeds at maturity, its petals united cup-like, its terminal more or less umbellate or corymbose inflorescences, and finally its leaves with the basal lobes covering each other, this species might perhaps be placed beside *Abutilon ibarrense* H. B. K., a plant widely distributed through South America. It differs however in having 18 instead of 20 carpids and in the 9 instead of 11–13 nerved leaves. The petioles are shorter, the calyx larger, and the petals much shorter, hardly emarginate and not deeply bilobulate. The plant is known among the natives under the name of *pañuelito*, i.e., "small handkerchief.

CARINIANA PYRIFORMIS Miers, Trans. Linn. Soc. **30**: 290. *pl. 63, f. 11.* 1874.

Arbor excelsa, nobilis, trunco erecto, coma elongata, ramis ramulisque cortice verruculoso, glabro, rufo-griseo, interdum in novellis purpurescente, tectis; foliis parvis, distichis, exstipulatis, petiolatis, coriaceis, petiolo brevi canaliculato, late marginato costaque subtus minutissime puberulo; laminis plus minusve ovato-ellipticis, basi rotundatis subcuneatisve, apicem versus sensim attenuatis, acumine acutato interdum valde elongato, supra obscure viridibus, lucidis, glaberrimis, costa venisque 18–20 impressis, subtus pallidioribus, dense albo-punctulatis, interdum subtiliter puberulis, costa prominente, venis primariis prominulis, in axillis membranosociliatis, venulis vix conspicuis, marginibus crenulatis; inflorescentia racemoso-composita, racemulis solitariis, binis, vel interdum 3–4-fasciatis, multifloribus, rhachide hirtello-tomentoso, rufescente; floribus alternis, pedicellatis, pedicellis ovarioque extus rufo-tomentosis, brevibus; sepalis ovato-lanceolatis, acutis, extus adpresse rufo-pubescentibus; petalis albidis, ovalibus, apice obtusis, extus minute pubescentibus, sepalis subduplo longioribus; androphoro parvo, irregulariter lobulato, valde obliquo, marginibus plus minusve fimbriatis; staminibus parvis, filamentis brevissimis, antheris bilocularis, loculis globosis; disco inconspicuo vel nullo; ovario infero 3-loculari, ovulis plurimis, biseriatis; pyxidio obconico, subpyriformi, apice truncato, applanato, 3-loculari; columella 3-quetra, operculo brevi cylindrico adnata; semina pro loculo 5–7, imbricata, obovato-elongata, alata.

Arbor usque ad 50 m. alta; 1.20 m. diam. Petioli 3–6 mm. longi; laminae 4–10 cm. longae, 2–3.5 cm. latae. Pedicelli circa 2 mm. longi. Sepala 2.5–3 mm. longa; 1.3 mm. lata. Petala 4.5–5 mm. longa, 2.3–2.6 mm. lata. Pyxidium 6.5–7.5 cm. longum, 5 cm. diam.; zona calycaris a basi 5.5–6 cm.

distans; vitta interzonalis 1.6–2 cm. lata; operculum 2.5–3 cm. diam., 0.8 to 1 cm. crassum; columella 5–5.5 cm. longa. Semina 13–15 mm. longa, 5–6 mm. lata.

Type from Betancí on the Río Sinú, State Bolívar, Colombia (Anthoine).

ZULIA: Forests along Lora River, Perijá and Colón Districts, flowers and fruits December 13, 1928 (*Pittier* 10934); the above description made on this collection.

In his extensive monograph of the Lecythidaceae,[11] Miers described and figured under the name of *Cariniana pyriformis*, fruits deposited in the collections of the Linnean Society of London and in the Kew Museum, the label of which, probably because of indistinct handwriting, was read as: "Betania, río Sinú, Bolivia." Hence the attribution of this species, in the Kew Index, to the Republic of Bolivia, a country probably far beyond the southern limits of the family area. Miers, however, had understood the labels to read: "Betania riviere sinu Plato Bolivia, New Granada," and so had correctly attributed the species to the last country, though his interpretation of the details was inaccurate. It is very likely that the label reads: Betanci, rivière Sinu, Estado Bolívar, New Granada, thus referring the origin of the fruits to the vicinity of the Betanci Lagoon, near the Sinù River in the State Bolívar of the actual Colombia. Miers' monograph was published in 1874, but in 1898, Niedenzu in his treatment of the Lecythidaceae in the *Pflanzenfamilien*[12] still attributes *Cariniana pyriformis* to Bolívia.

About 1910 or 1911, Sudworth and Mell, of the Forest Service of the United States Department of Agriculture, undertook the study of the wood known on the market as "Colombian Mahogani" which was imported into the United States from the port of Cartagena in Colombia. The identification of the wood was obtained through the study of its structure on one side, and by means of a branchlet with leaves and of a few pyxids that were turned over to me for determination on the other. Two plates with pictures of the leaves, fruits and seeds were published, both fairly good, except that the serratures of the leaves are too sharp and the fruits too short, but the original descriptions sent by me were so altered that they did not correspond any longer to the facts; several typographic errors were also overlooked. The branchlet in question, which, if I am not mistaken, is deposited in the U. S. National Herbarium, seems to correspond to a shoot, taken perhaps from a stump. The leaves are large as compared with those collected later and the branchlet itself is thin and flexible.

In 1922, it was my good fortune to find the tree itself in full bloom and growing abundantly in the forests of the Lora River, in the Venezuelan State Zulia, where it seemed well known under the vernacular name of *bacú*. I collected specimens with leaves and flowers and a good number of fruits with their corresponding seeds. These materials are the base of the description given above.

[11] Trans. Linn Soc. **30**: 1874.

[12] Abt. **7**: 40.

Of the genus *Cariniana* established by Casaretto in 1842, seven species have been described, all more or less completely. The fruit of *C. exigua* Miers, however, is unknown, and *C. pyriformis,* of the same author was heretofore known botanically only by its characteristic pyxids. But for two species, described by the founder of the genus, all the known ones have been described by Miers and there has been no attempt at a systematic characterization of them. Recently I received from Mr. A. Ducke, from the Jardim Botanico, Río de Janeiro, specimens of another species, related to *C. pyriformis*, but evidently new. I hope that able botanist and explorer will soon find time to publish it.

ANAECTOCALYX LATIFOLIA Cogn., in DC. Monogr. Phan. 7: 713. 1891.

This species has been found so far only in the mountains surrounding Colonia Tovar, State of Aragua. It is a shrub, 1 to 3 m. high, growing in clusters. The leaves are often sub-5–7-pli-nerved; the bracts which inclose the flower buds are disposed in terminal heads, 5–7 together; they are sessile and borne upon a common peduncle 0.5–1 cm. long. According to Cogniaux, the tube of the calyx is 1 cm. long, but our measurements give less, 5 to 8 mm., while we have only 11 mm., instead of 12–15, for the length of the lanceolate, caducous lobes. The white petals also seem to be shorter, 12 mm. instead of 13 to 17, and they are 10 mm. broad, more or less. Finally, the longest anthers reach 8 mm. The authors who have dealt so far with this genus have not known the fruit. It is a leathery capsule, adnate with the calyx tube and consequently silky-setose except at its free apex, which is open at the place where the thick style stood, and crowned with 6 diminutive teeth. The dimensions of the capsule are 7–9 mm. in length, with a diameter of 8 mm. The numerous seeds are straight, diminutive and inserted apparently on ramified dissepiments radiating from the axis of the capsule, one in each of the 6 cells.

The plant has been collected so far in the woods above Colonia Tovar, between 1900 and 2200 m., by Fendler (no. 441), Karsten, Voronoff and myself. I also found it at a short distance farther east, at the headwaters of the Chichiriviche River, in the temperate rain-forest at about 1800 m. above sea level, in flower Sept. 4th, 1918 (*Pittier* 8126).

The type species of this interesting endemic Venezuelan genus, *Anaectocalyx bracteosa* Triana, is from the Andes of Mérida and Trujillo, where it grows, according to Funck and Schlim (no. 745), Linden (no. 353) and Engel, at altitudes between 2000 and 4300 m. Moritz collected it in the neighborhood of Tovar, State of Mérida, which should not be confused with Colonia Tovar.

Cordia volubilis, Pittier sp. nov. (Sect. *Physoclada*)

Sublignosa, volubilis, caulibus elongatis, adscendentibus, rufo-hirsutissimis, ad nodos florigeros sacco laterali ovato munitis; foliis oppositis ternatis quaternisve, petiolatis, magnis; petiolis crassis, brevibus, dense rufo-villosis; laminis ovalibus, basi rotundatis subcordatis apice abrupte cuspidatis, supra costa nervibusque primariis leviter prominentibus villoso-setosis exceptis glabris, subtus pallidioribus, costa venisque parce piloso-setosis, venulisque valde prominentibus, demum glaberrimis; inflorescentiis cymosis, cymis ad nodos congregatis, pedunculatis, rhachide densiuscule rufo-setoso; pedunculis

brevibus vel interdum elongatis; floribus subsessilibus; alabastro ovoideo, utrinque acuto, parce hispido, apice setis plurimis longioribus producto; calyce membranaceo, bilabiato; corolla alba extus glabrescente intus usque ad insertionem staminum pilosa; staminibus supra medium tubi affixis, quam corollae lobis brevioribus; filamentis apice apiculatis; antheris ovatis basi profunde bilobulatis apice emarginatis; ovario subgloboso in disco cupulato totidem immerso, stylo basi crassiore adpresse hispido, medio bifido, ramis supra iterum bifidis; stigmatibus clavatis.

Caulis basin versus usque ad 1.5 cm. crassus; internodia 15 cm. longa. Petioli 4–10 mm. longi, laminae 10–32 cm. longae, 5.5–21 cm. latae. Pedunculi 0.5–12 cm. longi; pedunculi cymorum 0.4–1.5 cm. Calyx 6.5 mm. longus. Corolla 7.5 mm. longa (tubus 4.5 mm.; lobuli late ovati suborbiculatisve 3 mm. longi, 2.5–3 mm. lati). Discus (cum ovario immerso) 1 mm. altus; stylus usque ad bifurcationem 3 mm., crures 2.3–2.5 mm., stipita stigmatorum 0.4–1 mm.; stigmata circa 1 mm. longa.

This interesting species of Sect. *Physoclada* is very closely related to *C. nodose* Lam. It is not, however, a shrub with swollen nodes, but a decidedly voluble vine. Instead of swollen nodes the leaf, of each floriferous node only, is provided just underneath its insertion with a hollow pouch, used as a shelter by a ferocious ant. The leaves are much larger and only the rib and veins bear an almost setose, scarce indument. In the flowers, the stamens are inserted, not at the throat itself, but lower down in the tube; the anthers are ovate and obtuse, divided at the base in two lobes and distinctly emarginate at the apex. Finally, in the style, the basal part is longer, and the first and second divisions successively shorter. It is likely that a comparison between the Brazilian plant and ours would show further discrepancies.

Anguria longeracemosa Pittier, sp. nov.

Glaberrima, caulibus validissimis alte scandentibus, grosse sulcatis; foliis trifoliolatis, breviter petiolatis, petiolo crasso, anguloso, apice versus attenuato; foliolis coriaceis, modice petiolulatis, intermedio late obovato, basi cuneato apice versus grosse sinuato-dentato et abrupte breveque acuminato, lateralibus assymetricis basi binerviis breviter auriculatis, margine exteriori grosse sinuatis; nerviis validis supra impressis, subtus prominentibus; cirrhis robustis, elongatis; floribus masculis ignotis, foemineis racemosis, pedicellatis, 3–5-glomeratis; pedunculo communi robusto, elongatissimo, pedunculo; pedicellis crassis, sulcatis; receptaculo cylindrico, laevi; sepalis triangularibus, marginibus plus minusve revolutis, apice subacutis; petalis coccineis late obovatis, apice rotundatis, mucronatis, utrinque papillosis, conspicuiter 5-nervibus, nerviis secus marginem anastomosantibus; staminodiis 2, rudimentariis, ciliatis; ovario glabro, elongato, fusiformi; stylo ima crasso; stigmatum lobis oblongis, obtusis.

Caulis ad 8–12 m. longus, 2 cm. crassus, ad nodos incrassatus. Petioli 4.5–5 cm., petioluli 1.5–2 cm. longi; foliolum intermedium 21 cm. longum, 15–17 cm. latum, lateralia 18–20 cm. longa, 11–14 cm. lata. Racemi ad 50 cm. longi; pedicelli 1 cm. longi. Receptaculum 7–8 mm. longum. Sepala 2–2.5 mm. longa. Petala 5 mm. longa, 2.5–4.5 mm. lata. Ovarium 10–15 mm. longum.

PANAMÁ: Yaviza, southern Darien, on margin of forest; flowers April 22, 1914 (*Pittier* 6582, TYPE).

In the absence of the male flowers, it is difficult to place this new species exactly. It is likely, however, that its closer affinities are with *Anguria Warscewiczii* Hook., a species of Central and northern South America, which differs in the dimensions and shape of the leaves and in the solitary female flowers.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE ACADEMY

224TH MEETING

The 224th meeting, the 31st annual meeting, was held in the Administration Building of the Carnegie Institution of Washington on Tuesday, Jan. 8, 1929. The meeting was called to order at 8:18 P.M. by Vice-President HEYL. The retiring President, ROBERT B. SOSMAN, delivered an address on *Polymorphism in the System: Fe-O.* An abstract follows the report of the business meeting.

At the conclusion of the address there was a brief intermission, after which the President called the annual business meeting to order. The minutes of the 30th annual meeting, held Jan. 10, 1928, were read by the Recording Secretary and approved.

The report of the Corresponding Secretary, L. B. TUCKERMAN, was presented by him. He reported the election of 32 members during the year 1928 and the death of the following members: BRADSHAW H. SWALES, Jan. 23, 1928; SAMUEL ADAMS, Feb. 12, 1928; J. N. ROSE, May 4, 1928; WILLIAM H. BIXBY, Sept. 29, 1928; DAVID S. CARLL, Nov. 5, 1928; J. S. DILLER, Nov. 13, 1928; T. C. CHAMBERLIN, Nov. 15, 1928; ALEXANDER ZIWET, Nov. 18, 1928; S. J. MAUCHLY, Dec. 24, 1928; G. WYTHE COOKE, Dec. 26, 1928.

On Jan. 1, 1929, the membership consisted of 15 honorary members, 3 patrons, and 581 members, one of whom was a life member. The total membership was 599, of whom 391 reside in or near the District of Columbia, 174 in other parts of the continental United States, and 34 in foreign countries.

The Board of Managers held eight meetings, which were devoted mainly to routine business and consideration of revising the By-Laws and Standing Rules of the Academy. A revised draft of the By-Laws is nearly completed and will be presented to the Academy during the coming year. The average attendance was 13 members.

The report was ordered accepted.

The report of the Recording Secretary was presented by him. Six meetings in addition to the annual meeting were held during 1928, two being joint meetings. The subjects and names of the speakers were given. The report was ordered accepted.

The report of the Treasurer, R. L. FARIS, was presented by him. Among other items of interest it showed the following: Total receipts during 1928, \$5,549.68; total disbursements, \$6,496.15, including an investment of one thousand dollars in a real estate note. Bank balance Dec. 31, 1928, \$1,992.94. Value of investments, \$18,536.37. Estimated net worth, \$20,110.30.

The report of the Auditing Committee, consisting of ALEXANDER WETMORE, *Chairman*, F. B. SCHEETZ and JOHN A. FLEMING, was presented by its

chairman. The Committee reported that it had examined the books and report of the Treasurer and found them correct, and had verified the securities listed. The reports of the Treasurer and Auditing Committee were ordered accepted.

The report of the Board of Editors was presented by Mrs. AGNES CHASE. The eighteenth volume of the Journal consisted of 600 pages printed at an average cost of $5.92 per page, or with the cost of illustrations and certain overhead charges included, $6.50 per page. The report indicated the number of articles and the number of pages devoted to articles in the various branches of science. The report was ordered accepted.

The report of the Committee of Tellers, consisting of GEORGE W. MOREY, H. L. DRYDEN and C. H. KUNSMAN, was presented by the Corresponding Secretary. In accordance with the report the following were declared elected: *President,* ALEŠ HRDLIČKA; *Corresponding Secretary,* L. B. TUCKERMAN; *Recording Secretary,* W. D. LAMBERT; *Treasurer,* R. L. FARIS; *Non-resident Vice-Presidents,* H. S. GRAVES and FRIDTJOF NANSEN; *Member of the Board of Managers,* A. S. HITCHCOCK. For the other member of the Board of Managers, there was a tie vote between W. S. EICHELBERGER and WILLIAM R. MAXON. It was moved, seconded and carried that the tellers be instructed to determine the election in this case by lot and report the result to the Corresponding Secretary. (The lots drawn in accordance with this motion resulted in the election of W. S. EICHELBERGER.)

The Corresponding Secretary reported that the following members of the Academy had been nominated for Vice-Presidents by the affiliated societies: *Archaeological,* Dr. WALTER HOUGH, National Museum; *Biological,* Dr. E. A. GOLDMAN, Biological Survey; *Botanical,* Dr. ROBERT F. GRIGGS, George Washington University; *Chemical,* Dr. RALEIGH GILCHRIST, Bureau of Standards; *Engineers,* Mr. STARR TRUSCOTT, National Advisory Committee for Aeronautics; *Electrical Engineers,* Mr. C. A. ROBINSON, Chesapeake and Potomac Telephone Co.; *Entomological,* Dr. A. BÖVING, National Museum; *Foresters,* Mr. BARRINGTON MOORE, 1520 K Street, N. W.; *Geographic,* Dr. F. V. COVILLE, Bureau of Plant Industry; *Geological,* Dr. D. F. HEWETT, Geological Survey; *Mechanical Engineers,* Mr. H. L. WHITTEMORE, Bureau of Standards; *Military Engineers,* Major CAREY H. BROWN, 1621 New Navy Bldg., *Philosophical,* Dr. L. H. ADAMS, Geophysical Laboratory.

The members so nominated were unanimously elected Vice-Presidents.

No new business being presented, at 9:45 P.M. the meeting adjourned.

Address of the Retiring President of the ACADEMY, ROBERT B. SOSMAN, Research laboratory, United States Steel Corporation, Kearny, New Jersey: *On polymorphism in the system: Fe-O.* The atomic structures of iron and of oxygen, under the modified Bohr theory, permit a rational explanation of why iron and oxygen combine, and why they combine in more than one proportion, but they do not yet permit a prediction of the temperatures and pressures of equilibrium. The equilibria in the system involve the following distinctive features: (1) solid solution at high temperatures between Fe_2O_3 and Fe_3O_4, perhaps over a limited range only, but with indications from the form of the dissociation-pressure curves that the mutual solubilities diminish with falling temperature; (2) the eutectic relation between Fe_3O_4 and FeO; (3) limited temperature-range of stability for FeO, with dissociation into Fe and Fe_3O_4 below 500° or 600°; (4) liquid immiscibility between FeO and Fe, with limited solid solution of Fe in FeO and of FeO in Fe.

Iron and the three oxides, FeO, Fe_3O_4, and Fe_2O_3, all show "high-low" polymorphism of the type shown by quartz at 573°, and by many other substances. Iron shows the unusual phenomenon of a modification stable at low and at high temperatures (alpha-delta) but unstable and replaced by a second form at intermediate temperatures (gamma). Superposed on this system is the magnetic inversion (alpha-beta). The relations can be described in terms of two zeta curves intersecting at two points, together with a third zeta curve which has a different form and which can be displaced independently of the other two. Although insufficient for a complete interpretation, the data on the three oxides can be similarly described and classified, so far as they are available.

In addition to the stable forms: Fe_2O_3 (hematite, paramagnetic), Fe_3O_4 (magnetite, ferromagnetic), and FeO (paramagnetic), there is a ferromagnetic modification of Fe_2O_3 which is apparently monotropic but which has its own enantiotropic magnetic inversion point.

The system as a whole offers an excellent opportunity for the correlation of atomic, structural, magnetic, and thermodynamic points of view of the properties of crystalline substances. (*Author's abstract.*)

WALTER D. LAMBERT, *Recording Secretary.*

PHILOSOPHICAL SOCIETY

986TH MEETING

The 986th meeting was held in the Cosmos Club Auditorium, February 16, 1929.

Program: E. J. BROWN: *Precise longitude determinations of the U. S. Coast and Geodetic Survey.* A brief history of the developments in longitude determination during the past 100 years was given. The importance of devising a satisfactory means of time comparison between longitude stations was emphasized.

The use and development of wireless telegraphy as a means of signal exchange was discussed and a description and demonstration given of the type of short wave radio time signal receiver used for field work at the present time.

A method of using the carbon microphone button as a means of chronographically recording chronometer beats, in place of the regular break circuit device, was shown. The same audio frequency amplifier used to amplify the impulses from the microphone button served to amplify impulses from the transit circuit as well as the radio time signals from the short wave receiver. It was shown that in passing the impulses from the chronometer, transit, and radio circuits through a common amplifier and relay the appreciable time lags in these circuits were practically eliminated. (*Author's abstract.*)

A. H. MILLER of Ottawa, Canada: *Gravity investigations in Canada.* One hundred and sixteen gravity stations have so far been established in Canada. The greater part of these have been established in Western Canada and more particular attention has been paid to the study of the results in this part of the country. The base station is at Ottawa which has been connected directly by relative measurements with Washington, Greenwich and Potsdam.

The isostatic anomalies are on the whole rather small. This is particularly true of the mountainous province of British Columbia and also of the moun-

tainous and elevated regions of Alberta. The survey has been extended to the Arctic Ocean by the Mackenzie River and a series of stations has also been placed along the Pacific Coast on the western shores of Vancouver Island, the Queen Charlotte Islands and the mainland.

In all of Western Canada there are only two regions of definite isostatic anomalies and in both places the anomalies are positive. From measurements of the local rock densities it is concluded that the anomalies on the southern part of Vancouver Island are due to abnormally heavy rock beneath the stations. The large negative anomaly at Seattle and the large positive anomaly found in Canada at Victoria are illustrative of the fact that large anomalies are usually quite local and do not extend over large areas.

From the consideration of the fact that the prairies are known to be a quite stable region, one which has been subject to erosion for a long time, and from a comparison of the Coast and Geodetic Survey results for the Black Hills region, it has been concluded that the Saskatchewan anomalies probably do not represent a lack of isostatic equilibrium. It is more likely that they represent an extension or reappearance near the surface of the heavy pre-Cambrian floor which is exposed in the Black Hills region. Further gravity observations are required to determine in detail the extent of the structure.

A graphical determination from the results of 20 stations in the mountain gives a depth of approximately 100 kilometers for the depth of compensation.

A brief reference was made to an investigation in Europe of geophysical methods of prospecting for the Canadian government last season. Slides were shown of the new types of pendulum apparatus that have been developed by the Geodetic Institute at Potsdam and by Sir Gerald Lenox Conyngham at Cambridge.

The gravity connection between Potsdam, Greenwich, Ottawa and Washington is now being completed by observations that will be taken at the U. S. Coast and Geodetic Survey office by Mr. Miller. No result for Washington is yet available and the computations for the other stations, awaiting final clock rates, etc., are as yet in the preliminary stage. The preliminary value for Ottawa, however, indicates a somewhat larger value than that previously adopted. (*Author's abstract.*)

OSCAR S. ADAMS, *Recording Secretary.*

SCIENTIFIC NOTES AND NEWS

Volumes 1 to 4 of the Smithsonian Scientific Series are being distributed to subscribers to the de luxe edition of 875 copies. These volumes are entitled: *The Smithsonian Institution,* by WEBSTER PRENTISS TRUE; *The sun and the welfare of man,* by CHARLES GREELEY ABBOT; *The North American Indians,* by ROSE A. PALMER; *Minerals from earth and sky,* by GEORGE P. MERRILL and WILLIAM F. FOSHAG. The remaining eight volumes are well advanced in preparation and will probably be published during the present year. The Series is designed to give in an interesting way, richly illustrated accounts of subjects pursued at the Smithsonian Institution.

The Masaryk (State) University of Brno (Brünn), Moravia, has conferred the honorary degree of Doctor of Natural Sciences on Dr. ALEŠ HRDLIČKA on the occasion of his sixtieth birthday.

Mr. H. W. Hubbard, of Peking, China, recently visited the Division of Birds at the National Museum to examine specimens from Chihli Province. Mr. R. T. Webber, of the Gypsy Moth Laboratory, Melrose Highlands, Mass., spent some days in the Division of Entomology to study types and other specimens pertaining to a group of parasitic flies which he is describing.

Philip S. Smith, Chief of the Alaskan Branch of the Geological Survey, left on April 3 to attend the Fourth Pan-Pacific Science Congress in Java. He will go to Java by way of Europe and the Suez Canal, returning by one of the Pacific routes.

The Medical Society of the District of Columbia invited Dr. William Allen White, superintendent of St. Elizabeth's Hospital, to give the annual lecture of the Kober Foundation, at Georgetown University on March 25. His subject was "The Social Significance of Mental Disease."

Obituary

Robert Ridgway, ornithologist, Curator of Birds in the National Museum since 1880, and a member of the Academy, died at Olney, Illinois, March 25, 1929. He was born at Mount Carmel, Illinois, July 2, 1850. His scientific career began with his work as zoologist with the King Survey of the 40th Parallel and continued with vigor until his death, resulting in the publication of many important volumes and shorter papers in ornithology, a standard descriptive work on color, and papers in geographic botany. Mr. Ridgway's contributions to knowledge brought him many scientific honors, both at home and abroad, and he is considered to be the foremost ornithologist America has yet produced.

Ernest Lester Jones, geodesist, Director of the Coast and Geodetic Survey, and a member of the Academy, died at his home in Washington, April 9, 1926. He was born at East Orange, New Jersey, April 14, 1876, and studied at Princeton University; receiving the degrees of Bachelor and Master of Arts. He served as Deputy Commissioner of Fisheries from 1913 to 1915 and as Superintendent and Director of the Coast and Geodetic Survey from 1915 until his death. During the World War he was commissioned Colonel in the Division of Military Aeronautics of the Signal Corps, seeing active service and suffering injuries from gas that eventually caused his death.

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BOTANY.—*New plants mainly from western South America—II.*[1]
ELLSWORTH P. KILLIP, U. S. National Museum.

In the present paper eight new species of plants are described, five of which belong to the genus *Tropaeolum*. Two excellent treatments of this genus have been published, one a monograph of the entire genus by Buchenau[2] and the other a revision of the group with serrate-ciliate petals by D. K. Hughes.[3]

Urtica longispica Killip, sp. nov.

Urtica ballotaefolia macrostachya Wedd. in DC. Prodr. 16^1: 48. 1869; not *Urtica macrostachya* Wall.

Described as a variety of *Urtica ballotaefolia* Wedd. this plant appears to be sufficiently distinct to rank as a species. The spikes are much longer than in *U. ballotaefolia* and the achenes much smaller. The following specimens have been examined:

COLOMBIA: Cundinamarca: San Antonio, *Goudot* (Paris, TYPE). Caquetá: Balsillas Mountains, *Ariste Joseph* B 104 (U. S. N. M.). Norte de Santander: Western slope of Páramo del Hatíco, alt. 2800 meters, *Killip & Smith* 20727 (U. S. N. M.). Caldas: Salento, alt. 2800 meters, *Pennell* 9346 (U. S. N. M.). El Cauca: Río Paez basin, alt. 2500–3000 meters, *Pittier* 1379 (U. S. N. M.). Mount Puracé, alt. 3200 meters, *Pennell & Killip* 6671 (U. S. N. M.).

Escallonia lepidota Killip, sp. nov.

Branchlets puberulent; petioles up to 5 mm. long; leaves oblanceolate or oblong-spatulate, 3 to 6 cm. long, 1.5 to 3 cm. wide, rounded or acutish at apex, cuneate at base, closely serrulate, dark green and pilosulous above, paler and copiously covered with white scales beneath; flowers in a compact terminal raceme, 5 to 7 mm. long, 2.5 to 3 cm. wide, the pedicels up to 5 mm. long, lepidote; floral leaves none; calyx narrowly turbinate-campanulate, about 4 mm. long, 3 mm. wide at throat, densely lepidote, the teeth linear-

[1] Published by permission of the Secretary of the Smithsonian Institution. For Part I of this series see this JOURNAL **16**: 565–573. 1926. Received March 25, 1929.

[2] Pflanzenreich **4**, pt. 131: 1–36. 1902.

[3] *The "serrato-ciliata" group of* Tropaeolum. Kew Bull. Misc. Inf. **1922**: 63–85. 1922

subulate, 1 to 1.5 mm. long; petals linear-spatulate, 8 to 10 mm. long, 1 mm. wide at base, 2 mm. wide at the rounded, at length reflexed, apex, apparently white, with conspicuous dark veins; stamens and pistil 6 to 7 mm. long, the stigma slightly bilobed.

Type in the U. S. National Herbarium, no. 1,283,656, collected at San Carlos, central Chile, February, 1926, by Brother Claude Joseph (no. 3867).

This is related to *E. arguta* Presl and *E. leucantha* Remy, but is at once distinguished by the conspicuous white scales on the pedicels, calyx, and under side of the leaves, and by the absence of floral leaves.

Escallonia patens (R. &. P.) Killip

Stereoxylon patens R. &. P. Fl. Peruv. & Chil. 3: 13. *pl. 234, fig. b.* 1802.

This has been confused with *E. myrtilloides* L. f. from the northern Andes, but is certainly distinct. Specimens examined are:

PERU. Prov. Huanta: Tambo, 3200 meters, *Weberbauer* 5585 (Field Mus.). Prov. Moquegua: Carumes, 3300 meters, *Weberbauer* 7267 (U. S. N. M., Field Mus.).

Tropaeolum flavipilum Killip, sp. nov.

Scandent herb; stem slender, short-villosulous throughout with yellowish hairs; stipules none; petioles 3 to 6 cm. long, subcirrhose, villosulous like the stem; leaves broadly lance-ovate in general outline, 4.5 to 5.5 cm. long, 4.5 to 5 cm. wide, 3-lobed (lobes rounded or obtuse, the lateral much reduced, the middle lobe triangular-ovate, about 2 cm. wide at base), truncate or slightly convex at base, 5-nerved, peltate (proportion above petiole to below petiole 4 or 5: 1), densely appressed-pilose on both surfaces with yellowish hairs, red-mottled beneath; peduncles about 6.5 cm. long, cirrhose; flowers 5.5 cm. long, finely pilosulous without; spur about 4.5 cm. long, 0.8 cm. wide at base, straight, gradually tapering to apex, pink; sepals broadly ovate, about 8 mm. wide, obtuse, green; petals 5 to 6 mm. long, unguiculate-spatulate, truncate and ciliate-serrate at apex, deep purple; the upper petals about 4 mm. wide, the lower about 3 mm. wide.

Type in the U. S. National Herbarium, no. 1,351,868, collected near Las Vegas, Department of Santander, Colombia, altitude 2800 meters, December 23, 1926, by E. P. Killip and Albert C. Smith (no. 16095).

This resembles somewhat the Ecuadorean species *T. adpressum* Hughes, but the leaf lobes are rounded, the flowers larger, and the indument is denser and is yellow rather than white.

Tropaeolum concavum Killip, sp. nov.

Scandent herb, glabrous throughout; stems slender; stipules none; petioles very slender, 5 to 9 cm. long, subcirrhose; leaves depressed-orbicular in general outline, 4 to 4.5 cm. long, 5 to 6 cm. wide, angulately 5-lobed (lobes obtuse, not mucronulate, the lower reduced), concave at base, peltate (proportion above petiole to below petiole 7: 1), pale and minutely papillose beneath; peduncles filiform, 3 to 3.5 cm. long, cirrhose; flowers 2.5 cm. long; spur 1.5 cm. long, 3 mm. wide at apex, very slightly curved, red; sepals oblong, 5 to 6 mm. long, 4 mm. wide, obtuse, red; petals yellow (?), cuneate-spatulate, 6 mm. long, 3.5 mm. wide, serrate-ciliate at the truncate apex, yellowish (?), the upper gradually, the lower abruptly tapering to an unguiculate base.

Type in the herbarium of the New York Botanical Garden, collected at Angelopolis, near Medellín, Department of Antioquía, Colombia, January 22, 1928, by R. A. Toro (no. 890).

Related to *T. fintelmanni* Wagener, but with proportionately longer, distinctly lobed leaves, which are deeply concave at base.

Tropaeolum septangulum Killip, sp. nov.

Scandent herb, glabrous throughout; stem slender, the internodes 3 to 6 cm. long; stipules none; petioles 3 to 6 cm. long, subcirrhose; leaves rounded-ovate, 3.5 to 4.8 cm. long, 3.5 to 5 cm. wide, shallowly and broadly 7-lobed (central lobes callous-thickened at apex), peltate (proportion above petiole to below petiole 3 to 3.5:1), straight or very slightly convex at base, pale and reddish-blotched beneath, epapillose; pedicels about 7 cm. long, slender, subcirrhose; flowers 3 to 3.5 cm. long; spur 2 to 2.5 cm. long, about 5 mm. in diameter at base, abruptly tapering at middle to a very slender apex, straight or slightly curved, yellow at base, green at apex; sepals erect, broadly ovate, 7 to 8 mm. long, 6 to 7 mm. wide, obtuse, red; upper petals ovate-oblong, 10 mm. long, 3 to 4 mm. wide, unguiculate, aristate-lobed, ciliate to base, yellow proximately, red distally; lower petals oblong-spatulate, 7 to 8 mm. long, 3 mm. wide, aristate-lobed above, red.

Type in the U. S. National Herbarium, no. 1,355,568, collected along the western side of the Culagá Valley, north of Labateca, Department of Norte de Santander, Colombia, altitude 1,480 to 1,550 meters, March 12, 1927, by E. P. Killip and Albert C. Smith (no. 20539).

In the shape of the leaves, with the callous-thickened lobes, this species strongly resembles *T. moritzianum* Kl.; but in *T. septangulum* the petals are distinctly aristate-lobed, not merely ciliate-serrate, resembling, in this respect, the petals of species no. 30–38 in Buchenau's monograph.[2]

Tropaeolum macrophyllum Killip, sp. nov.

Scandent herb; stem slender, rather sparsely (or at nodes densely) hirsute with hyaline hairs; stipules none; petioles slender, 6 to 7 cm. long, subcirrhose, hirsute like stem at base, otherwise glabrous; leaves orbicular-ovate, 7 to 8 cm. long, 7 to 8.5 cm. wide, 5-lobed (lobes broadly obtuse, the middle lobe broadly ovate, pronounced, the lower lobes reduced), convex at base, peltate (proportion above petiole to below petiole about 3:1), thin-membranous, glabrous, bright green on both surfaces, mottled with red and epapillose beneath; peduncles very slender, pubescent like the petioles; flowers about 5.5 cm. long, sparingly pubescent with crispate hyaline hairs; spur 4.5 cm. long, 7 mm. wide at base, straight, yellow-green at apex, pinkish red elsewhere; sepals broadly ovate, about 7 mm. wide, obtuse, pinkish red; petals not exserted, 5 to 7 mm. long, deep purple, dentate-ciliate above, the upper cuneate-spatulate, the lower ovate, short-unguiculate at base; filaments deep purple; anthers gray-pink.

Type in the U. S. National Herbarium, no. 1,352,739, collected at California, Department of Santander, Colombia, altitude 2200 meters, January 13, 1927, by E. P. Killip and Albert C. Smith (no. 17093).

This is nearest *T. coccineum* Hughes, though because of the pubescent flowers it would scarcely fit into that branch of Miss Hughes' key.[3] The differences between the two species may be shown thus:

Leaves less than 6.5 cm. long and wide, 3-lobed, the central lobe acute; flowers glabrous; upper petals spatulate-oblong. T. COCCINEUM.

Leaves more than 6.5 cm. long and wide, 5-lobed, the lobes broadly obtuse; flowers pubescent; upper petals cuneate-spatulate. T. MACROPHYLLUM.

Tropaeolum huigrense Killip, sp. nov.

Scandent herb; stem softly pilosulous with white crispate hairs, at length glabrous; stipules none; petioles 3 to 5 cm. long (the lower up to 25 cm. long),

pubescent like the stems, or glabrous; leaves suborbicular, 2.5 to 4.5 cm. long, 3 to 5.5 cm. wide (lower leaves up to 12 cm. long, 13 cm. wide), 7-lobed (all but central lobe much reduced, the lobes broadly rounded, submucronulate), truncate or slightly undulate at base, peltate (proportion above petiole to below petiole 11:5), softly pilosulous with crispate hairs on both surfaces, paler beneath; flowers 1.5 to 2 cm. long, finely and softly pilosulous with crispate hairs; spur 1 to 1.2 cm. long, 1.5 mm. wide at base, slightly curved, yellow, green at apex; sepals narrowly oblong, 8 to 10 mm. long, 2 mm. wide, obtuse, greenish yellow; petals yellow, with orange veins, the 2 upper ovate-spatulate ones 10 to 11 mm. long, 5 mm. wide, gradually tapering to an unguiculate base, the 3 lower, 9 to 10 cm. long, suborbicular in upper third, crispate at apex, abruptly narrowed, the lower two-thirds narrowly linear, long-ciliate at margin just below the dilated portion.

Type in the U. S. National Herbarium, no. 1,022,061, collected in the vicinity of Huigra, Province of Chimborazo, Ecuador, August 28, 1918, by J. N. Rose and George Rose (no. 22408). Additional specimens, from the same locality, are *Hitchcock* 20618 and *Rowlee & Mixter* 1182.

The general shape of the leaves of this species and especially the crispate indument are strongly suggestive of *T. peltophorum* Benth. In Buchenau's key this species clearly would come next to *T. peltophorum* because of the fact that the lower petals are entire at apex and strongly ciliate below the dilated portion. Otherwise the flowers are quite different; in *T. huigrense* the flowers are yellow and the spur about 1 cm. long and only 1.5 mm. wide at base; in *T. peltophorum* the flowers are scarlet, green at the tip of the spur, and the spur is 2 cm. long, gradually enlarging to 3 mm. wide at base.

Tropaeolum hughesae Killip

Tropaeolum trilobum Hughes, Kew Bull. Misc. Inf. **1922**: 85. *fig. A* (p. 84). 1922; not *T. trilobum* Turcz. (1858).

Type locality: Afradita, near Fusagasuga, Department Cundinamarca, Colombia (*André* 1386).

Additional specimen examined: COLOMBIA: El Peñon, southwest of Sibaté, Department Cundinamarca, altitude 2800–2900 meters, *Pennell* 2412.

Loasa vestita Killip, sp. nov.

Erect suffruticose herb, about 1 meter high, the stem 1 cm. thick at base, densely white-pilose with subreflexed hairs and sparingly setose below, rufo-pilose and densely setose above; leaves subsessile, lanceolate or oblong-lanceolate, 3 to 14 cm. long, 1.5 to 4 cm. wide, acute at apex, rounded or acutish at base, pinnately lobed (or the upper merely dentate), thick, rugose, hispid above, densely hirsute on the nerves beneath with appressed white or yellowish brown hairs, sparingly setose; pedicels recurved or ascending, up to 2 cm. long, setose; calyx broadly obconic, 0.5 to 1 cm. long, 0.7 to 0.8 cm. in diameter at throat, densely setose, the lobes ovate-lanceolate, 6 to 8 mm. long, acute; petals concave, 1.5 to 2 cm. long, abruptly narrowed below middle, strongly setose on the nerves without, white; scales triangular-ovate, 6 to 7 mm. long, bisaccate toward base, callose-thickened above middle, deeply bifid at apex (teeth about 2 mm. long), white, transversely banded with blood-red; staminodia 2 with each scale; stamens about 50, the filaments 1 cm. long, anthers oval, 1 mm. long; capsule cylindric-obconic, up to 2.5 cm. long.

Type in the Field Museum of Natural History, no. 562,511, collected on grass steppe, near Huaillay, north of Huanta, Province of Huanta, Depart-

ment of Ayacucho, Peru, altitude 3500 to 3600 meters, March 13, 14, 1926, by A. Weberbauer (no. 7591). Duplicate in the U. S. National Herbarium.

In Urban and Gilg's monograph of Loasaceae this species would come between *Loasa poissoniana* Urb. & Gilg and *L. schlimiana* Pl. & Linden. From both it is readily distinguished by the very dense, white or brown indument on the under side of the leaves.

Tournefortia curvilimba Killip, sp. nov.

Branchlets sulcate, finely rufo-hirsutulous; petioles 3 to 4 cm. long, canaliculate above, glabrescent; leaves alternate, ovate-oblong, 12 to 15 cm. long, 6 to 7 cm. wide, attenuate-acuminate at apex, acute and subdecurrent at base, undulate, penninerved (lateral nerves 10 to 12 pairs), reticulate-veined, glabrous, finely and sparsely pilosulous with whitish hairs; inflorescence terminal, dichotomous, the flower-bearing portion of the branches about 5 cm. long, though apparently not fully developed; flowers short-stipitate; calyx lobed nearly to base, the lobes linear-lanceolate, 4 to 5 mm. long, 1 mm. wide at base, glabrous or with a few fine whitish hairs; corolla 8 to 10 mm. long, the tube about 2 mm. in diameter, the limb 6 to 7 mm. wide, strongly recurved, the lobes obtuse; stamens borne near middle of tube; anthers linear, about 2 mm. long; stigma subsessile.

Type in the herbarium of the Botanical Museum, Upsala, collected at El Chaco, Province Sur Yungas, Department La Paz, Bolivia, altitude, 1900 meters, December 3, 1920, by E. Asplund (no. 1360).

Allied to *T. undulata* R. & P., which it rather closely resembles in foliage, the proposed species is distinguished by larger flowers, the limbs of which are strongly recurved, and by more elongate anthers and a subsessile stigma.

BOTANY.—*A new species of* Aristida *from Florida.*[1] JASON R. SWALLEN, Bureau of Plant Industry. (Communicated by A. S. HITCHCOCK.)

In a collection of grasses recently received for identification at the Grass Herbarium of the U. S. Department of Agriculture from Dr. Paul Weatherwax, there was an unusual species of *Aristida*. The North American species of this genus were revised in 1924 by Professor A. S. Hitchcock,[2] and Dr. J. Th. Henrard[3] has published a study of the types of *Aristida* for the whole world, preliminary to a monograph of the genus. Since the species sent by Dr. Weatherwax is not accounted for in either of these works, it may be described as new. It differs from most species of *Aristida* in the presence of rhizomes, which character suggests the specific name.

[1] Received April 2, 1929.

[2] Contr. U. S. Nat. Herb. **22**, pt. 7. 1924.

[3] *A critical revision of the genus* Aristida. Med. Rijks Herb. Leiden **54**: 1–220. 1926; **54A**: 221–464. 1927; **54B**: 465–701. 1928.

Fig. 1.—*Aristida rhizomophora*, base of plant, ½ nat. size; spikelet, × 2 dia.; two views of callus, × 10 dia.

Aristida rhizomophora sp. nov.

Plants perennial; culms tufted, simple, erect, 65 to 80 cm. tall, producing well developed scaly rhizomes; leaves one or two, the lower internodes short; sheaths persistent, becoming fibrous with age, smooth, with a tuft of hairs at the mouth, especially on those of the innovations, nearly lacking on those of the culm; ligule nearly obsolete; blades firm, flat or folded, somewhat scabrous above, smooth beneath, 7 to 10 cm. long, 1 to 2 mm. wide, those of the innovations flexuous, as much as 30 cm. long; panicle flexuous, 20 to 30 cm. long, the branches two at a node, distant, flexuous, somewhat spreading, few-flowered, spikelet-bearing from near the base, the lower ones as much as 7 cm. long; glumes acuminate and usually awned, the awn 1 to 6 mm. long, the first 1 to 3-nerved, 8 to 14 mm. long, the second 1-nerved, 12 to 17 mm. long including the awn; lemma glabrous, 9 to 12 mm. long, the callus 1 mm. long, sharp-pointed, short-bearded on the sides above, the awns scabrous, flexuous, curved or loosely twisted at the base, spreading, the central often reflexed by a semicircular bend, 18 to 24 mm. long, the lateral 15 to 20 mm. long.

Type in the U. S. National Herbarium, no. 1,435,634, collected in the prairie region north of Lake Okeechobee, near Fort Bassenger, Florida, June 30, 1928, by Dr. Paul Weatherwax (no. 1081).

The other North American species of *Aristida* which produce rhizomes are *A. stricta* Michx., and *A. patula* Chapm. In the former they are exceptional (*Garber* in 1877, *Hitchcock* 19767, *Standley* 13076, and *Weatherwax* 1088) and such specimens can be distinguished from *A. rhizomophora* by the strict panicle with more numerous, smaller spikelets, and the dense pubescence on the upper surface of the blades near the base. In the latter they occur frequently, but the species, which belongs to a different group, has large panicles with stiffly spreading branches, as much as 20 cm. long, naked below.

In the form of the panicle and spikelets, *A. lanosa* Muhl. resembles *A. rhizomophora*, but the plants are stouter, usually solitary, with densely lanate pubescent sheaths and flat blades, as much as 4 mm. wide, tapering to a fine involute point.

BOTANY.—*A diminutive new hollyfern from Ecuador.*[1] WILLIAM R. MAXON, U. S. National Museum.

Among some plants collected in the Andes of Ecuador by H. E. Anthony and G. H. H. Tate in 1923, and submitted to the U. S. National Herbarium for identification, is the following hollyfern, which seems never to have been described.

Polystichum pumilio Maxon, sp. nov.

Rhizome (incomplete) relatively stout, 2.5 cm. long, about 3 cm. in diameter, decumbent, conspicuously paleaceous; scales thin, lustrous, ferruginous in mass (discoloring with age), mostly oblong-ovate to broadly oblong-attenuate, hair-pointed, the margins laxly and distantly long-fibrillose, some of the underlying scales narrowly lance-attenuate, subdenticulate toward the apex. Fronds several, closely cespitose, erect from a curved base, 10–17 cm. long, the stipes short (2–5 cm. long), 1–1.5 mm. thick above the base, paleaceous, the scales broad, mostly erose-denticulate and freely fibrillose; blades narrowly lance-attenuate, 8–12 cm. long, 1.5–2 cm. broad in the lower part, bipinnate; rachis strongly paleaceous, the scales large, spreading, similar to those of the stipe but soon fuscous; pinnae 25–30 pairs, contiguous, slightly oblique, those of the lower half 9–12 mm. long, elongate-triangular from a subequilateral base (here 6–7 mm. broad), pinnate, with 4 or 5 pairs of spreading or reflexed, inequilateral, deeply concave, subdistant segments, the leaf tissue dull green, subcoriaceous, bearing a few minute fibril-like scales; segments spatulate to rounded-trapeziform, cuneate at base, unequal, the distal basal one largest, bilobed (the minute rounded distal auricle rarely free), the others simple; upper pinnae gradually simpler, with broad acutish or rounded subentire tips, much reduced, those of the attenuate tip minute; margins subentire or remotely dentate; sori small, apparently exindusiate, solitary in the smaller segments, 4 or 5 in the larger ones.

Type in the U. S. National Herbarium, no. 1,424,988, collected at Urbina, Chimborazo, Ecuador, at an altitude of 3,475 meters, Oct. 22–28, 1923, by H. E. Anthony and G. H. H. Tate (no. 394).

[1] Published by permission of the Secretary of the Smithsonian Institution. Received March 23, 1929.

FIG. 1.—*Polystichum pumilio* Maxon. Natural size

Polystichum pumilio belongs to the Andean group of *P. polyphyllum* Presl and is perhaps most closely related to that species itself. From *P. polyphyllum,* however, using that name even in its most inclusive conventional sense, it differs widely in its wholly non-spinulose and really minute segments. Although a dwarf in stature, it seems normal in every respect and gives no indication of being a reduced form of some species which normally grows to large size.

ZOOLOGY.—*Initial stratigraphic survey of nemas in the upper 20 mm. of marine beach sand, near low tide mark.*[1] N. A. COBB, Bureau of Plant Industry.

In 1916 studies at the laboratory of the Bureau of Fisheries, Woods Hole, Massachusetts, showed that sandy beaches, far from being utterly barren, carry a comparatively rich fauna of microscopic organisms. What biological and economic rôle these organisms may play is little known. Conceivably they may be more important than would at first be suspected. Recall that many larger aquatic organisms, at one period or another, may pass a certain amount of time on the bottom. During this sojourn their relationship to the microscopic inhabitants of the sand, mud, etc. constituting the bottom, is a matter about which we know very little, but it is easy to imagine that sometimes the relationship may be important. Again, the sand- and mud-inhabiting organisms themselves may be temporary stages (eggs, larvae) in a varied life history.

Such thoughts led to a stratigraphic examination of marine beach sand at Woods Hole, August, 1928. A small sheet-metal box, 10 centimeters square, carrying a series of thin metal slides was devised, such that by its aid layers of sand 5 mm. thick, lying one above another in series, could be collected (Figs. 1 and 2). In each of two collections four such successive horizontal layers were examined for their nemas. The results are indicated in the following tables:

Collection I:	Layer No. I	topmost	1st 5 mm.	100 sq. cm.	905 nemas
	" " II		2nd "	" "	1,355 "
	" " III		3rd "	" "	1,009 "
	" " IV		4th "	" "	175 "

Collection II:	Layer No. I	topmost	1st 5 mm.	100 sq. cm.	1,512 nemas
	" " II		2nd "	" "	1,403 "
	" " III		3rd "	" "	981 "
	" " IV		4th "	" "	226 "

Only two collections were made, as the census is a very tedious one. It will be seen that the two collections, taken a few yards apart, give

[1] Received April 8, 1929

rather consistent stratigraphic numbers; so that we may say, as a result of these two examinations, that probably the number of nemas in each successive layer decreases, rather gradually at first, but *rapidly* below the third 5 mm. layer; i.e., to a depth of about 15 mm. the sand is thickly populated with nemas; below that level the number falls off rapidly. The deeper layers contain fewer nemas, and fewer species.

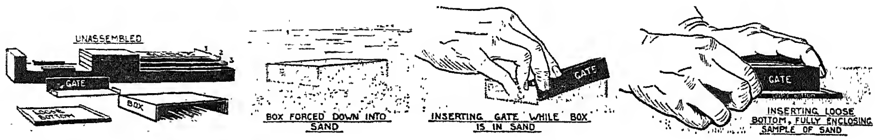

Fig. 1. See also Fig. 2. Apparatus for collecting layers of sand and mud on beaches, mud flats, and at the bottom of ponds, lakes and seas. The unassembled apparatus is shown at the left; its use in collecting is explained in the successive illustrations in Figs. 1 and 2, reading from left to right. All the operations except the last must be performed at the time of collecting. The last operation may take place in the laboratory. The rectangular collecting box, with two sides missing, is forced into the sand or mud. The two missing sides (gate and loose bottom) are then inserted, as shown above. To insert the loose bottom the adjacent sand is pawed away.

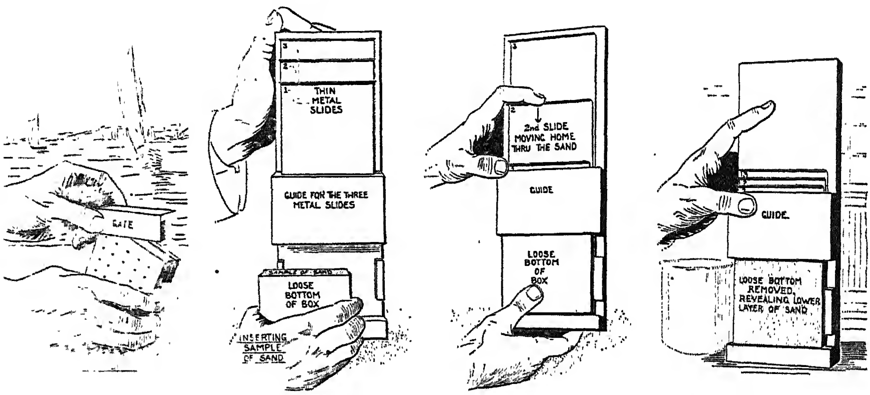

Fig. 2. See also Fig. 1. After the sample of sand is removed from the bottom, it is placed in a holder having three thin metal slides (1, 2, 3), that can be forced through the sand parallel to each other, thus cutting it into four layers;—in this case each layer is 5 mm. thick. After the slides are forced home, as shown at the right, the loose bottom of the box is removed, disclosing the lowest layer of sand,—5 mm. thick. This is washed into a beaker and treated as desired. The top of the box has fine perforations in order to allow the supernatant water to escape without disturbing the top layer of sand or mud. To prevent the possible escape of small organisms, this perforated top may be further covered with the finest bolting silk, stretched on.

Averaging the figures from the two collections mentioned above, it will be seen that, if they are typical collections, the beach sand examined carried about 3,742,000,000 nemas per hectare in the top 20 mm., or about 1,500,000,000 per acre. In 1916, but earlier in the summer, an examination of the same beach showed at least 1,040,000,-000 per acre in the topmost inch of sand.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

PHILOSOPHICAL SOCIETY OF WASHINGTON

987TH MEETING

The 987th meeting was held in the Cosmos Club Auditorium, March 2, 1929.

Program: A. Q. TOOL: *On the relation between the refractivity and the annealing of glass.* By extending investigations which have been the subject of previous reports it has been found that the refractivities of glasses are materially influenced by the effective annealing temperature.[1] The influence of this temperature on the refractivity is not confined to the higher annealing temperatures alone but also extends throughout the whole of the practical annealing range. In this range equal reductions in the effective annealing temperature produce practically equal increments in the refractivity of a given glass. In many cases this linear relation appears to extend well below the lower limit of practical annealing but the time required for the glass to reach a physico-chemical equilibrium at such temperatures makes a thorough investigation difficult.

The increases in refractivity per degree Centigrade decrease in the effective annealing temperatures have been determined for a number of glasses and include the following: Medium Flint, 0.000024; Dense Flint, 0.000036; Soda Lime Crown, 0.000032; Borosilicate Crown, 0.000048; Light Barium Crown, 0.000047; Barium Flint, 0.000030.

These values are strictly applicable only to the melts for which they were determined and may also be subject to some slight modification as the investigation proceeds. They show, however, that the refractivity of a glass which is annealed according to a schedule chosen for its speed and efficiency in the case of small pieces may differ by at least one in the third decimal from that of the same glass annealed according to a schedule which is efficient for very large pieces.

Any refractivity increase caused by a reduction of the effective annealing temperature can be obliterated by reannealing the glass according to a schedule which will increase that temperature to its original value. In other words these changes in the refractivity are reversible and as a consequence the refractive index of a glass can always be readjusted, within narrow limits, by reannealing. (*Author's abstract.*)

I. C. GARDNER: *The optical depth gage.* This instrument is analogous to the self-contained coincidence-type military range finder except that the two optical systems united by the coincidence prism are microscopes instead of telescopes. The magnifying power is approximately 90 diameters and the axes of the two systems are inclined to each other at an angle of 25°. A range finder coincidence-prism provides a circular field divided by a diameter. The images formed by the two microscopes are brought into the two halves of the field respectively, and are so focused that the dividing line and images are without parallax.

[1] The effective annealing temperature resulting from any annealing schedule is that temperature corresponding to the physico-chemical equilibrium condition which most nearly resembles the particular condition produced in a glass by the annealing. These equilibrium conditions, which vary with the temperature and are reversible, are never actually reached by ordinary annealing procedures although at times they may be closely approached.

When an object is at the intersection of the two optical axes the images formed by the two microscope objectives are in coincidence at the center of the dividing line. Suitable fine adjustments are provided for bringing the two halves of the field into this relative position with precision. If the object is displaced along the line of sight by as little as 3 or 4 microns, it is detected by the lack of coincidence of the two fields. One therefore has an optical depth gage with a working distance between objective and object of approximately 50 mm., and with the probable error of a single observation of a displacement in the line of sight not greater than 3 of 4 microns. By having the instrument suitably mounted with precision ways, such as are used with the comparator or traveling microscope, displacements normal to the line of sight can be measured in the usual manner. The present instrument has been designed to be used for the measurement of internal screw threads and for this purpose it is provided with a special nose piece carrying an objective prism and an opaque illuminator of normal design. It can be used for any purpose where accurate measurements in the direction of the line of sight, as well as normal to it, are desired. As there is no physical contact between the instrument and the surface to which the measurement is to be made, it is particularly applicable to measurements where the pressure due to physical contact of the more usual methods introduces deformation which prevents the attainment of the desired precision. (*Author's abstract.*)

988TH MEETING

The 988th meeting was held in the Cosmos Club Auditorium, March 16, 1929.

Program: WILLIAM J. PETERS: *Compass and dip circle deviations caused by harmonic motion.* Analyses of magnetic results in the vicinity of intersections of the tracks of the *Carnegie* have confirmed the existence of systematic errors, such as had been anticipated as a consequence of different conditions of the motion of the vessel on the different tracks. Studies of the effects of simple harmonic motion of the magnetic instrument upon its own results have been made, but so far as investigated, no corrections based upon theory alone can be considered adequate or reliable. It might be found, eventually, that empirical methods will be more practical, but experiment and theory will aid in developing these methods. Experiments have been made in the Standardizing Observatory of the Department of Terrestrial Magnetism with compasses mounted in a wooden swing which is constrained to move like a pendulum in vertical planes without twisting, and the following facts have been noted: (*a*) When the vertical plane of the swing's motion is N-S, that is, when the axle of the swing is E-W, oscillations of the compass may be seen but, generally speaking, they are small and the mean reading of the lubber-line will not differ materially from the mean reading when at rest. (*b*) When the axle is lying N-S, oscillations are usually seen, sometimes quite large, but the mean reading again is nearly the same as at rest. (*c*) When the axle is lying in any other direction and notably in an intercardinal direction, the mean reading of the lubber-line when the swing is in motion will usually differ from the readings taken when the swing is at rest and hence give rise to deviations which seem to be fairly permanent so long as the amplitude of the motion of the swing remains constant. (*d*) The deviations for axle NE-SW will have an opposite sign to the deviation for axle SE-NW. (*e*) The sign of the deviation and its magnitude are peculiar to each compass. (*f*) The magnitude of the deviation and the amplitude of the card oscillations increase with the amplitude of the swing and the radius.

In the early stages of these experiments before the wooden swing was constructed it was assumed that the deviations could be explained entirely by the "dynamic deviations," which had been investigated and so named by Bidlingmaier. Applying Langrane's equation of motion to the ship and the instrument on board, he deduces a general expression for the deviation, δ, in the form of five factors, $\delta = \mathrm{N{\cdot}S{\cdot}I{\cdot}P{\cdot}L}$, which he designates as the numerical, the ship, the instrument, the period and the direction factor. Computed for compass Ritchie 39670, as in the wooden swing oscillating 11° either side, $\delta = -0.05$ which has the opposite algebraic sign and is less than 2 per cent of the deviation observed. It might be noted also, that δ changes sign only with the period factor for any one heading, that is, it changes only as the compass period is greater or smaller than the ship period whereas about half of the experiment results have opposite signs while no compass has a period smaller than that of the swing, $3\frac{1}{4}$ seconds.

It appears therefore that Bidlingmaier's dynamic deviations, which are based upon an eccentric center of mass in the magnet, are modified or masked by conditions other than he considered.

Oscillations of the compass card at sea caused by the tilting of the card under the influence of accelerations of the pivot point in the rolling motion of the ship were investigated by Sir William Thomson who called them the kinetic equilibrium error. He did not, however, consider the permanent or quasi-permanent deviation that might result from these oscillations. Thomson's kinetic equilibrium error is identical with the tilting error of compases in a banking aeroplane which has been investigated by Starling. Let ζ, represent the heading counted eastward from north, ψ, the angle of tilt positive down to starboard, a, the vertical angle between the plane of the horizon and the intersection of the tilted plane of the card with the vertical plane of the meridian and b, the angle between the tilted plane and the vertical plane of the magnetic meridian. These four quantities are elements of a right angled spherical triangle. Also let I, represent the magnetic inclination, and F, the total intensity of the Earth's magnetic field. Then the components of F, one along the intersection of the tilted plane with the vertical plane of the magnetic meridian and the other perpendicular to this intersection and in the plane of the vertical meridian are $F \cos (I + a)$, $F \sin (I + a)$. The latter may be resolved into the components $F \sin (I + a) \sin b$, $F \sin (I + a) \cos b$.

The three components $F \cos (I + a)$, $F \sin (I + a) \sin b$ and $F \sin (I + a) \cos b$ may be represented by three mutually perpendicular edges of the parallelepiped constructed on the vector F and having one face, the upper coinciding with the plane of apparent level. The compass card is assumed to move in and only in this plane and therefore would turn until the magnetic axis coincided with the direction of the resultant of $F \sin (I + a) \cos b$ and $F \cos (I + a)$. A dip needle would move freely only in the plane perpendicular to the plane of apparent level and would therefore take the direction of the resultant of the two components $F \cos (I + a)$ and $F \sin (I + a) \sin b$. Accordingly if I_ψ be the observed magnetic inclination $\tan I_\psi = \tan (I + a) \sin b$. An example of the values of I_ψ and I shows that $I_\psi - I$ is negative on all headings except E and W where it is zero for this region of positive magnetic inclination.

In a similar manner the value of the component H of F in the plane of apparent level is derived from the components thus $H_\psi = F\,[\cos^2 (I + a) + \sin^2 (I + a) \cos^2 b]^{\frac{1}{2}}$

The angle δ in the plane of apparent level between this resultant and the

intersection with the vertical plane of the magnetic meridian is the deviation in direction of the resolved field and is given by $\tan \delta = \tan (I + a) \cos b$ As illustration of the values of δ, let $I = 71°$, $\zeta = 45°$ or $225°$ and $\psi = +10°$ then $\delta = +30°$, and for $\psi = -10°$, $\delta = -14°$, the mean of which is $+8°$, and this is the deviation that would occur in the mean result of an even number of consecutive readings of compass card of negligible mass and no damping.

The deviations indicated in all of the examples are very large. They are, however, only the instantaneous deviations of the resolved elements in the tilted plane from the normal values at the instant that the apparent level is inclined $+10°$ or $-10°$ to the true gravitational level. They are not the actual deviations of a compass card, for example, which has a period too great and a damping too strong to permit of keeping pace with the oscillating field.

This theory of tilting deviations does not explain the change of sign observed in the experiments on the same heading for different compasses nor does it explain the difference in magnitude for different compasses. It can only be regarded for the present as combining in some way with dynamic deviations to account only in part for the observed deviation.

In comparing the experiment deviations with systematic errors at sea it should be noted that for tilting deviations the angle of tilt will be about $\frac{1}{3}$ or $\frac{1}{5}$ of the angle of roll and also for both dynamic and tilting deviation the average roll during a series of magnetic observations is generally somewhat less than the roll noted by clinometer as installed on the *Carnegie*. (*Author's abstract.*)

H. B. MARIS: *The formation of spiral nebulae.* Briefly summarized, the universe as we know it is made up of about 300,000 groups of stars or nebulae. Adjacent groups are separated by a distance equal to roughly 100 times the diameter of a single group. The average group is made up of about 40 billions of stars which average a little larger and a little brighter than our sun. These star groups are moving relative to us with velocities which average something over 300 km. per second. There seems to be a certain uniformity of motion for most of the groups as they are apparently moving away from a common origin. Within each group there seems to be a certain uniformity of motion outward away from the center of mass of the group. Finally, there is coming to us, out of the vast reaches of space beyond the milky way, a peculiar penetrating radiation. This radiation might be produced by temperatures of from 1 to 100 billion degrees or it might be produced by atomic collision at velocities greater than 3000 km./sec. such as would be produced by electrical excitation voltages of 1 to 100 million volts. Perhaps the most astounding thing about this radiation is its magnitude, for the total energy flux per cm.^{2} is equal to or greater than the total energy flux of heat and light from stars.

The estimated density of pentrating radiation is $3 \cdot 10^{-4}$ ergs/cm.^{2} or one tenth that of star light on earth. However, we are situated near the center of a star group and out beyond this group in inter-glactic space the total energy of star light is probably less than that of the penetrating radiation. In other words, the activity involved in producing this penetrating radiation which comes to us apparently from nowhere is as great or greater than the total activity of the stars in producing light and heat. The formation of nebulae, the movement of stars along the spiral arms away from the center of the nebulae and the possibility of emission of penetrating radiation from the nebulae are discussed in the following paragraphs.

The velocity of escape from the average spiral nebulae is about 100 km. per second. This is true whether the escaping mass is a star of mass 10^{33} grams or a single molecule. A nebula moving through space will then sweep up scattered molecules of space and leave a decreased density in its wake. If we assume the space density estimated by Eddington and that our galaxy sweeps out a cylinder of space with a radius of 14 thousand light years at a velocity of 400 km. per second its mass would be doubled by the pick-up in 100 million years. The walls of such a hole in space would spread away from the center and in spreading would form clouds of low luminosity. If the radius of the hole left behind by a nebula were 300 light years the action of gravity would be so weak the hole would close by diffusion. Likewise if the density of mass in space were 10^{-30} as assumed by Jeans, a hole of radius 14 thousand light years would be closed by diffusion.

The walls of a cylinder of radius $1.3 \cdot 10^{-21}$ cm. swept out of space of density 10^{-23} will acquire an outward velocity of 2 km./sec. in 10 years. The velocity will be 70 km./sec. when the radius of the expanding cylinder is doubled and 500 km./sec. when the radius is equal to the radius of the galaxy. This is apparently a sufficient explanation of both the high velocities observed among nebulae and their apparent motion away from a common center.

A gaseous sphere with a radius of 9.10^{23} cm. and with original density 10^{-30} gm./cm.^{3} (Jeans estimate) will expand by diffusion to a 50 per cent increase in the radius before the velocities of gravity fall will start shrinkage. This estimate can probably be considered a maximum for the radius and a minimum for the density of a contracting gas sphere. A sphere of radius 10^{21} cm. and original density 10^{-23} (Eddington's estimate) will likewise expand by diffusion to a 50 per cent increase in radius before gravity shrinkage will start. The estimate can probably be considered a minimum for the radius and a maximum for the density of a contracting gas sphere which would form a spiral nebula. The mass of such a sphere would be 4.10^{39} gm. or about 1/20000 the mass of our galaxy.

A sphere of density 10^{-23} and radius $4.4 \cdot 10^{22}$ cm. or 46 thousand light years would have a mass of 10^{44}, about equal to our galaxy. The outer limit of such a sphere would attain a velocity of contraction of 12 km. in 10^7 years. In 50 million years the radius would be reduced to 10^{22} cm., the velocity of contraction of the outer rim would be 400 km./sec., and the total energy of motion of the mass would be equal to that of the same mass at a temperature of 9 million degrees K. The radius would be reduced from 10^{22} cm. to 10^{21} cm. in about 3 million years; the velocity of contraction would then be over 1000 km. per second and the total energy would be equal to a temperature energy of 90 million degrees. The actual temperature of the mass, however, would probably remain at about the 10,000° estimated by Eddington since motion of the outer rim of the nebula 1000 light years away would have little effect on the temperature of the center.

The next decrease of an order of magnitude in the radius of the nebulae would be accomplished in 56 thousand years. The velocity of contraction at this time would be about 4,000 km./sec. or great enough to give rise to penetrating radiation. The radius of the sphere at this time in its development would be 10^{20} cm. or about three thousand light years; the density would be $3 \cdot 10^{-17}$. The remainder of the contraction would be accomplished in a little over 10 thousand years so there would be very little time for cooling or diffusion of energy.

If the contracting mass finally reached a density of 1 the radius would be equal to the radius of Neptune's orbit. The force of gravity would be $8 \cdot 10^3$

or 100,000 times gravity at the earth's surface. Since the total mass would be $2 \cdot 10^{11}$ that of the sun the pressure at the center would be 10^7 greater than the pressure at the center of the sun. The temperature of adiabatic compression would be 10^{14} degrees and the total energy of contraction would be equal to a temperature energy of 10^{15} degrees. Light pressure necessary to explode the star with a force sufficient to give the component parts outward velocities of 200 to 300 km. observed in the arms of spiral nebulae would require a temperature of 10^{11} degrees. Consequently for a time at least the nebulae would be in a condition to emit penetrating radiation. (*Author's abstract.*)

RALPH E. GIBSON. *A simple volume—temperature relation for liquids.* If ρ_l is the density of a liquid, ρ_g the orthobaric density of its vapor, T_k the critical temperature and K is a constant which is independent of the temperature but varies from liquid to liquid, the equation

$$\log \frac{1}{\rho_l - \rho_g} = K - 0.3 \log (T_k - T)$$

is shown to hold accurately over large ranges of temperature for normal liquids. The equation is of such general application that its slope (0.3) is taken as a function of the normal thermal expansion which is constant for all liquids and deviations are attributed to change in molecular association.

In the light of this hypothesis it appears that the alcohols and acetic acid resemble water in that the polymer is less dense than the simple substance. By applying the equation to water one may calculate the percentage of polyhydrol in water at any temperature, the heat of the reaction polyhydrol $\rightleftharpoons$ hydrol and the true latent heat of melting of ice. (*Author's Abstract.*)

OSCAR S. ADAMS, *Recording Secretary.*

SCIENTIFIC NOTES AND NEWS

Helium, 97 per cent pure, is now being produced by the Bureau of Mines plant near Amarillo, Texas, at the rate of 30,000 cu. ft. per day, for the use of the Army and the Navy. The helium is concentrated from natural gas of the Cliffside structure, which contains about $1\frac{3}{4}$ per cent by volume. As there is only one part of helium in 185,000 parts of the atmosphere, the origin of so much helium in natural gas is a decided mystery.

JOURNAL

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GENERAL SCIENCE.—*Report of the committee on the 1929 revision of the Academy's list of one hundred popular books in science.* PAUL R. HEYL, Chairman.

The following books, 17 in number, are now out of print, and have consequently been removed from the list:

GENERAL WORKS.

Curtis, Winterton C.	Science and human affairs.

SCIENCES OF MAN.

ANTHROPOLOGY

Mason, O. T.	The origins of invention.
Hough, Walter	The Hopi Indians.

SCIENCES OF LIFE.

GENERAL BIOLOGY

Thomson, J. Arthur	The haunts of life.

ZOOLOGY

Stone, Witmer, and Cram, W. E.	American animals.
Mayer, Alfred G.	Sea-shore life.

BOTANY

Darwin, Charles	Insectivorous plants.

SCIENCES OF THE EARTH.

THE EARTH'S SURFACE

Bonney, T. G.	The work of rains and rivers.
Bonney, T. G.	Volcanoes.

THE AIR AND THE OCEAN

Humphreys, W. J.	Weather proverbs and paradoxes.
Talman, C. F.	Our weather.

SCIENCES OF THE HEAVENS.

Ball, Robert S.	The story of the heavens.
Dyson, F. W.	Astronomy.
Abbott, Charles G.	The sun.

SCIENCES OF THINGS AND EVENTS.

PHYSICS

Boys, C. V.	Soap bubbles.
Mach, Ernst	Popular scientific lectures.

SCIENCES OF FORM AND RELATIONS.

DeMorgan, Augustus	On the study and the difficulties of mathematics

The following books, 13 in number, have been recommended for removal from the list by different members of the Committee, as later books are now available giving a more up-to-date view of the subjects:

SCIENCES OF MAN.

ANTHROPOLOGY

Wissler, Clark	Man and culture.
Haddon, A. C.	The races of man.

HUMAN PHYSIOLOGY

Huntington, Ellsworth	Civilization and climate.

SCIENCES OF LIFE.

ZOOLOGY

Beebe, C. W.	Jungle peace.
Bouvier, E. L.	The psychic life of insects.
Fabre, J. H.	Social life in the insect world.

BOTANY

Hardy, M. E.	The geography of plants.

ANCIENT LIFE

Lucas, F. A.	Animals of the past.

SCIENCES OF THE EARTH.

Gregory, J. W.	Geology of to-day.
Lull, R. S., and others.	The evolution of the earth and its inhabitants.
Cole, Grenville A. J.	Rocks and their origins.
Merrill, George P.	The first one hundred years of American geology.
Brigham, Albert T.	Geographic influence in American history.

To replace the foregoing, the following thirty books have been recommended by members of the Committee:

A GENERAL VIEW.

Huxley, Julian. *Essays in popular science.*
(Alfred A. Knopf, New York, 1927.)

Bragg, Sir William. *Creative knowledge.*
(Harper & Brothers, New York, 1927. 258 pp.)
Simple explanations of fundamental principles of such industries as those of the sailor, the potter, the miner, the dyer, the weaver, and the smith, with illustrations of the primitive development of these trades. What everybody ought to know but what few do.

Newman, H. H., and others. *The nature of the world and man.*
(University of Chicago Press, 1926.)
A series of articles by members of the faculty of the University of Chicago describing the modern view of Nature in its different aspects.

SCIENCES OF MAN.

ANTHROPOLOGY

Wissler, Clark. *The American Indian.*
(Douglas C. McMurtrie, New York, 1917. 435 pp., illus.)
Deals with the types, environments, habits, customs, and other phases of Indian culture.

Hough, Walter. *The story of fire.*
(Doubleday, Doran & Co., New York, 1928. 198 pp. and 30 illus.)

Hrdlička, Aleš. *The old Americans.*
(Williams & Wilkins Co., Baltimore, 1925. 438 pp., illus.)
Studies the old American stock, its history, formation,

characteristics, changes in the New World, and discusses the evolution of a new American type.

Kroeber, A. L. *Anthropology.*
(Harcourt, Brace & Co., New York, 1923. 523 pp.)

SCIENCES OF LIFE.

HEREDITY

Jennings, H. S. *Prometheus.*
(E. P. Dutton & Co., New York, 1925.)
A brief discussion of heredity in relation to man.

GENERAL BIOLOGY

Haldane, J. B. S. *Possible worlds.*
(Harper & Brothers, New York, 1928. 305 pp.)
Deals with a number of biological problems in relation to man.

Mason, Frances (Editor). *Creation by evolution.*
(The Macmillan Co., New York, 1928. 392 pp.)
A collection of chapters on evolution in non-technical language by twenty-five leading biologists and zoologists of England and the United States. Admirably adapted for giving modern views of the various phases of the question.

ZOOLOGY

Beebe, Charles William. *Beneath tropic seas.*
(G. P. Putnam's Sons, New York, 1928. 234 pp. and 60 illus.)
The author gives in a popular form the high lights of an expedition to Haiti to study the Haitian fishes and the life of a coral reef at close range by means of a diving helmet and motion pictures taken in the water.

Wheeler, William Morton. *The social insects.*
(Harcourt, Brace & Co., New York, 1928. 378 pp. and 79 illus.)
Twelve lectures delivered at the University of Paris. Deals with the scope and meaning of the social among insects, with polymorphism and the evolution of wasps, bees, ants, and termites, and the evolution of the guests and parasites of social insects.

Forel, Auguste. *The social world of the ants.*
(G. P. Putnam's Sons, New York, 1928. Vol. 1, 551 pp. and 95 illus.; vol. 2, 445 pp. and 138 illus.)
Summing up a century of research on the anatomy, physiology, and psychology of the ants, the author elucidates a philosophy of the biological problems of man by the sensory and instinctive behavior of the ants. Forel's large work may remain a classic in the same sense as Darwin's "Origin of species."

BOTANY

Bower, O. F. *Plants and man.*
(The Macmillan Co., New York, 1925. 365 pp., illus.)
A popular or semi-popular book written by a recognized authority. It is correct and sound botanically and also readable and interesting.

Berry, Edward Wilber. *Tree ancestors—a glimpse into the past.*
(Williams & Wilkins Co., Baltimore, 1923. 270 pp. and 48 illus.)

Rolfe, R. T., and Rolfe, F. W. *The romance of the fungus world.*
(Chapman & Hall, Ltd., London, 1925.)
An account of fungus life in its numerous guises, both real and legendary.

MICROSCOPIC LIFE

DeKruif, Paul. *Microbe hunters.*
(Harcourt, Brace & Co., New York, 1929.)
A history of the development of our knowledge of micro-organisms in relation to disease; centers around the leading figures in this field of biology.

ANCIENT LIFE

Knowlton, Frank H. *Plants of the past.*
(Princeton University Press, 1927. 275 pp. and 90 illus.)
A popular and scientific account of the appearance and progress of plant life on the earth.

SCIENCES OF THE EARTH.

Cleland, H. F. *Geology, physical and historical.*
(American Book Co., New York, 1916. 718 pp., illus.)
A treatise on geologic science as a whole on a scale adequate for the general reader.

Lee, Willis T. *Stories in stone.*

(D. Van Nostrand Co., New York, 1926. 226 pp. and 52 illus.)

Chapters on various geologic topics, such as the Grand Canyon, ancient landscapes, Triassic, Jurassic, and Cretaceous scenes, in non-technical language.

Brewster, Edwin T. *This puzzling planet.*

(Bobbs-Merrill Co., Indianapolis, 1928. 328 pp., illus.)

Similar to "Stories in stone."

Schuchert, Charles, and LeVene, Clara M. *The earth and its rhythms.*

(Appleton & Co., New York, 1928. 385 pp.)

Similar to "Stories in stone" in general plan but more comprehensive.

Geikie, Sir Archibald. *The founders of geology.*

(The Macmillan Co., New York, 1905. 468 pp.)

A very interesting account of the growth of geologic knowledge from antiquity to the present, with biographic sketches of the men who have contributed most to the building of the science.

THE EARTH'S SURFACE

Bowman, Isaiah. *Forest physiography.*

(J. Wiley & Sons, New York, 1911. 759 pp., illus.)

Treats of physiography and physiographic regions of the United States, especially in their relations to forestry.

Henderson, Junius B. *Geology in its relation to landscape.*

(The Stratford Co., Boston, 1925. 152 pp., illus.)

Treats in popular style of the relations of landscape to the character and structure of the underlying rock formations.

Sciences of the Heavens.

Abbot, C. G. *The earth and the stars.*

(D. Van Nostrand Co., New York, 1925.)

This book is for non-technical readers, and not for the professional astronomer. It has been the aim of the author to present the most salient of the facts in simple words, and in such relations as will display our present views of why and how the celestial host came to be as it is.

SCIENCES OF THINGS AND EVENTS.

PHYSICS

Eddington, A. S. *The nature of the physical world.*
(The Macmillan Co., New York, 1929. 353 pp.)
A comprehensive discussion of the new physical conceptions and their philosophical consequences as seen by the chief British exponent of Einstein's theory of relativity. Gives in non-mathematical language the new views of gravitation, the quantum theory, the non-Euclidian geometry and the wave theory of matter.

Bragg, Sir William. *Concerning the nature of things.*
(Harper & Brothers, New York, 1925. 249 pp.)
An explanation of the modern conceptions of the constitution of matter, especially the structure of crytals, to which field the author has been a foremost contributor.

Heyl, Paul R. *Fundamental concepts of physics.*
(Williams & Wilkins Co., Baltimore, 1926.)
A summary of the development of physical thought and experiment from the eighteenth to the twentieth century.

SCIENCES OF FORM AND RELATION.

Cajori, Florian. *History of mathematics.*
(The Macmillan Co., New York, 1919. 514 pp., illus.)
This book has for years been the standard work on the subject in English. Well classified and readable.

The complete list, omitting descriptive paragraphs, is as follows:

A GENERAL VIEW.

1.	Huxley, Thomas Henry	Selections from Huxley.
2.	Huxley, Julian	Essays in popular science.
3.	Bragg, Sir William	Creative knowledge.
4.	Newman, H. H., and others	The nature of the world and man.
5.	Slosson, Edwin E.	Keeping up with science.

SCIENCES OF MAN.

PSYCHOLOGY

6.	Thorndike, Edward L.	The human nature club.
7.	James, William	Psychology.
8.	Woodworth, Robert S.	Psychology; a study of mental life.

ANTHROPOLOGY

9. Osborn, Henry Fairfield	Men of the old stone age.
10. Wissler, Clark	The American Indian.
11. Hough, Walter	The story of fire.
12. Hrdlička, Aleš	The old Americans.
13. Kroeber, A. L.	Anthropology.

HUMAN PHYSIOLOGY

14. Sherman, H. C.	Food products.
15. Eddy, Walter H.	The vitamine manual.
16. Jordan, E. O.	Food poisoning.
17. Keen, William Williams	Medical research and human welfare.

SCIENCES OF LIFE.

HEREDITY

18. Darwin, Charles	The origin of species.
19. East, E. M., and Jones, D. F.	Inbreeding and outbreeding.
20. Castle, W. E., Coulter, J. M., Davenport, C. B., East, E. M., and Tower, W. L.	Heredity and eugenics.
21. Conklin, E. G.	Heredity and environment.
22. Galton, Francis	Hereditary genius.
23. Popenoe, Paul, and Johnson, R. H.	Applied eugenics.
24. Jennings, H. S.	Prometheus.

GENERAL BIOLOGY

25. Thomson, J. Arthur.	The wonder of life.
26. Lucy, William A.	Biology and its makers.
27. Haldane, J. B. S.	Possible worlds.
28. Mason, Frances (Editor)	Creation by evolution.

ZOOLOGY

29. Buckley, A. B.	The winners in life's race.
30. Nelson, E. W.	Wild animals of North America.

31. Roosevelt, Theodore	African game trails.
32. Chapman, Frank M.	Camps and cruises of an ornithologist.
33. Maeterlinck, Maurice	The life of the bee.
34. Jenkins, Oliver P.	Interesting neighbors.
35. Blatchley, W. S.	Gleanings from nature.
36. Beebe, Charles William	Beneath tropic seas.
37. Wheeler, William Morton	The social insects.
38. Forel, Auguste	The social world of the ants.

BOTANY

39. Ganong, W. F.	The living plant.
40. Osterhout, W. J. V.	Experiments with plants.
41. Sorauer, Paul	A popular treatise on the physiology of plants.
42. Towsend, C. W.	Sand dunes and salt marshes.
43. Bower, F. O.	Plants and man.
44. Berry, Edward Wilber	Tree ancestors.
45. Rolfe, R. T., and Rolfe, F. W.	The romance of the fungus world.

MICROSCOPIC LIFE

46. Vallery-Radot, Réné	Louis Pasteur, his life and labours.
47. DeKruif, Paul	The microbe hunters.

ANCIENT LIFE

48. Knowlton, F. H.	Plants of the past.
49. Hutchinson, H. N.	Extinct monsters and creatures of other days.

SCIENCES OF THE EARTH.

50. Cleland, H. F.	Geology, physical and historical.
51. Hawkesworth, Hallam	The strange adventures of a pebble.
52. Lee, Willis T.	Stories in stone.
53. Brewster, Edwin T.	This puzzling planet.
54. Schuchert, Charles and Levene, Clara M.	The earth and its rhythms.
55. Geikie, Archibald	The founders of geology.
56. Semple, Ellen Churchill	Influences of geographical environment.

57. Spurr, J. E. (Editor)	Political and commercial geography of the world's mineral resources.

THE EARTH'S SURFACE

58. Bowman, Isaiah	Forest physiography.
59. Tyndall, John	The forms of water in clouds and rivers, ice and glaciers.
60. Henderson, Junius B.	Geology and the landscape.
61. Russell, Israel C.	Volcanoes of North America.
62. Davison, Charles	The origin of earthquakes.

THE AIR AND THE OCEAN

63. Brooks, Charles F.	Why the weather?
64. Ward, R. deC.	Climate, considered especially in relation to man.
65. Murray, John	The ocean.

SCIENCES OF THE HEAVENS.

66. Abbot, Charles G.	The earth and the stars.
67. Hale, George S.	The new heavens.
68. Lewis, Isabel M.	Splendors of the sky.
69. Murphy, E. G. (Kelvin McKready, pseud.)	A beginner's star book.
70. Turner, H. H.	A voyage through space.
71. Berry, Arthur	A short history of astronomy.

SCIENCES OF THINGS AND EVENTS.

CHEMISTRY

72. Slosson, E. E.	Creative chemistry.
73. Hendrick, Ellwood	Everyman's chemistry.
74. Fuller, Henry C.	The story of drugs.
75. Fabre, Jean Henri	The wonder book of chemistry.
76. Duncan, Robert Kennedy	The chemistry of commerce.
77. Martin, Geoffrey	Modern chemistry and its wonders.
78. Soddy, Frederick	The interpretation of radium.
79. Venable, F. P.	A short history of chemistry.
80. Smith, Edgar Fahs	Chemistry in America.

PHYSICS

81. Soddy, Frederick	Matter and energy.
82. Mills, John	Within the atom.

83.	Einstein, Albert	Relativity.
84.	Fleming, J. A.	Waves and ripples in water, air and aether.
85.	Miller, Dayton C.	The science of musical sounds.
86.	Bragg, William	The world of sound.
87.	Luckiesh, M.	Color and its applications.
88.	Soddy, Frederick	Science and life.
89.	Eddington, A. S.	The nature of the physical world.
90.	Bragg, Sir William	Concerning the nature of things.
91.	Heyl, Paul R.	Fundamental concepts of physics.

SCIENCES OF FORM AND RELATION.

92.	Ball, W. W. Rouse	Mathematical recreations and problems.
93.	Whitehead, A. N.	Introduction to mathematics.
94.	Conant, Levi Leonard	The number concept, its origin and development.
95.	Young, John Wesley	Lectures on the fundamental concepts of algebra and geometry.
96.	Cajori, Florian	A history of mathematics.
97.	Smith, David Eugene	Number stories of long ago.

HISTORY OF SCIENCE.

98.	Libby, Walter	An introduction to the history of science.
99.	Sedgwick, W. T., and Tyler, H. W.	A short history of science.
100.	White, Andrew D.	A history of the warfare of science with theology in Christendom.

EVOLUTION.—*Zoogenesis.*[1] AUSTIN H. CLARK, U. S. National Museum.

It is a readily demonstrable fact that every living thing is the child of some other living thing. It is utterly impossible for any living thing to appear spontaneously. Since all living things are derived from other living things, it naturally follows that the ancestral line of every living thing in the world at the present time has been continuous and unbroken, going back to the very earliest life upon the earth. No biologist at the present day doubts the continuity of life from parent

[1] Received April 5, 1929.

to child through all the ages that have passed since life's first beginnings, or the common origin of all forms of life.

Every living thing develops from a particle of living matter—a single germ cell—in which no trace of the adult form of that living thing is discernible. Since every animal, no matter what it is, originates as a single cell, we are safe in assuming that all types of animal life must be explained in terms of a primitive single cell.

The course of development of animal forms from those whose body is composed of a single cell to the multitudes of multicellular types which we know today is explained by what is called the theory of evolution.

Evolution as commonly understood assumes the gradual development step by step of all the widely varying forms of animal life from an original form of simple structure. But the developmental course which has been followed by animal life can not be reduced to any such simple formula. There are three separate sets of facts to be considered, and any acceptable theory of animal development must harmonize and correlate all three.

In the first place, within each of the so-called phyla or major groups of animals, as is well seen in the vertebrates, particularly in the mammals and the reptiles, there are many well marked, obvious, and undeniable evolutionary lines which, beginning with a relatively simple form of creature, run by easy stages to a specialized and highly complex form.

In the second place, very few of these evolutionary lines are perfectly continuous. Practically all of them are more or less frequently interrupted by gaps of various widths, and these gaps are often very broad. Especially is it true that these evolutionary lines tend to be separated from each other for their entire course, running parallel right down to their very earliest beginnings and not converging to a common type of animal as we would expect. For instance, the cat line and the dog line are always separate. No forms intermediate between cats and their relatives and dogs and their relatives are known, although both cats and dogs are collateral members of that great group of mammals known as the Carnivora and therefore must have had a common ancestor. Similarly, there are no intermediates between turtles and snakes, or between turtles and lizards, all of which are reptiles, or between squid and oysters, though both types are mollusks.

In the third place, no animals are known even from the very earliest rocks which can not be at once assigned to their proper phylum or major group on the basis of the definition of that group as drawn up

from a study of living animals alone. A backboned animal is always unmistakably a backboned animal, a starfish is always a starfish, and an insect is always an insect no matter whether we find it as a fossil in the rocks or catch it alive at the present day. There can be only one interpretation of this entire lack of any intermediates between the major groups of animals, as for instance between the vertebrates, the echinoderms, the mollusks and the arthropods. If we are willing to accept the facts at their face value, which would seem to be the only thing to do, we must believe that there never were such intermediates, or in other words that these major groups from the very first bore the same relation to each other that they do at the present day. Is this creationism? Not at all. It simply means that life at its very first beginnings from the single cell developed simultaneously and at once in every possible direction. All of the phyla or major groups seem to be of simultaneous development—at least we have no evidence that it was otherwise. From each one of these after its appearance a separate evolutionary tree arose, growing upward through the ages.

The numerous developmental lines are explained by the process of *evolution* as that term is commonly understood, and this descriptive word should be restricted to these developmental lines.

The gaps within these lines, and between related lines which run more or less parallel, are explained by an extension of the theory of *mutations*.

The complete absence of any intermediate forms between the major groups of animals, which is one of the most striking and most significant phenomena brought out by the study of zoology, has hitherto been overlooked, or at least ignored. This condition may readily be explained from an application of the facts gained through the study of embryology by a theory which may be called the theory of *primagenesis*.

Restriction or expansion of the meaning of a well known word results always in confusion. The term evolution is commonly used to cover the entire developmental history of animals. But evolution contemplates a gradual and continuous unfolding of animal life beginning with creatures consisting of a single cell and ending with man. A better understanding of the subject will result if we recognize the fact that this process includes three distinct but interrelated phases, first, *evolution* properly so called; second, *mutations;* and third, *primagenesis*.

If we regard the complete history of the development of animal life in this light, we must, in order to avoid confusion, use for it an entirely new term. We may call it *zoogenesis*.

Evolution

To illustrate evolution as here restricted, let us briefly review the history of the mammals and the reptiles, bearing in mind that similar histories are found in many other less familiar forms of life.

The reptiles first appeared in that very ancient time which is known to geologists as the Carboniferous and gradually increased in diversity and in maximum size. The largest land animals of which we have any knowledge are the largest of the dinosaurs which flourished in those periods known as the Jurassic and Cretaceous. At the end of the Cretaceous period most of the larger and more spectacular of the reptiles suddenly disappeared, but many reptilian types, for instance the turtles, lizards, snakes and crocodilians, continued right through to the present day.

The mammals first appeared in the form of very small and insignificant creatures at the time when the great reptiles were the dominating giants of the land and sea. After the sudden disappearance of the giant reptiles they increased greatly in diversity and somewhat in size, though in the earlier portion of the epoch following (Eocene) the largest mammal was not so large even as a sheep.

These mammals of the earlier portion of the "dawn period" (Eocene) soon disappeared; but as they disappeared their place was taken by other types which were more or less comparable to the sorts we know today. Gradually as time went on these mammals became more and more diversified. Various extraordinary types, some of huge size, appeared and not long afterwards disappeared, while together with these came others which we have no difficulty in recognizing as the direct predecessors of the types we know at the present day.

In order to make the picture clearer let us narrow our perspective and focus our attention on the horses. In the Eocene we find a curious little creature no bigger than a fox called the "dawn horse"—*Eohippus*. This had four toes on the front and three on the hind feet and a relatively short head with the eyes about half way between the ears and the tip of the nose instead of nearer the ears than the tip of the nose as in the later horses.

Following the "dawn horse" we find a number of different kinds of horses mostly about the size of a shepherd dog or a little larger, all of which had three toes. Like the "dawn horse" and its relatives, they had low crowned teeth which were affixed to the jaw by means of roots.

Still later there are horses which as colts had low crowned teeth, but

when fully grown had teeth with fairly high crowns. With these lived others in which the teeth had high crowns at all ages. These horses had shorter muzzles and rather less deep jaws than the modern horse, and while they had a single hoof there was a toe on either side of it. These lateral toes varied from small ones which did not reach the ground to larger ones which reached the ground. Though these were larger than their predecessors, they were not so large as the later horses.

In the Pleistocene or Ice Age we had in North America many different kinds of horses which were all of the modern type with long high crowned teeth and deep jaws. They ranged in size from little ones no bigger than the smallest Shetland pony to some which were larger than the largest draught horses. Before the discovery of America by the Europeans all of these had disappeared, for what reason we do not know.

There is an interesting and significant correlation between the interrelationships of animal types at the present day, their life history, and their fossil record which, though of the greatest importance from the point of view of animal evolution, seems never to have been pointed out.

Among the vertebrates the least diversified of the included classes is that which includes the birds while the most diversified is that which includes the fishes.

All birds exhibit a similarity in the broader features of their structure which, considering their numbers and the very great diversity in the minor structural details, is surprising. In conformity with this, birds in their embryonic stages and in their pre-adult existence exhibit a uniformity which is without parallel among the vertebrates.

All birds lay eggs which are enclosed within a rigid and at the same time brittle calcareous shell. There are among them no viviparous forms such as occur among the mammals, reptiles, fishes and amphibians. The eggs are always large, and are provided with abundant food material. From the egg the chick emerges in a well developed—sometimes in a very highly developed—stage.

In all birds except the megapodes the young are assiduously tended by their parents, or by one parent, until nearly or quite the full size is reached. In all birds the embryo develops within a rigid envelope permitting but little deviation from the general type represented by the parents. Furthermore, the young, dependent on the ministrations of one or both the parents, must be of such a nature as to be able to receive and to profit by parental care, and also to stimulate it. This

still further restricts the possibility of wide deviation from a general type.

So all the birds, both fossil and living, excepting for the ancient toothed birds and the *Archæopteryx*, are very closely allied and in spite of the vast range in size, from Princess Helen's hummingbird to the ostrich, the birds form a much more unified group than do the mammals, reptiles, amphibians or fishes.

In the vertebrates the interrelationships and the evolutionary history of the types in the several included classes are largely a reflection of the possibilities for variation afforded in the early stages. In the invertebrates this is even more striking as is at once brought out if we compare the insects with any one of the larger groups of marine invertebrates.

Mutations

The variability in the continuity of the evolutionary lines leads naturally to a consideration of mutations. While in many animal types we are able to trace, as in the horses, a gradual evolution from a form which is simple and generalized in structure to one or many forms which are highly specialized, this is by no means always true. Indeed, it is the exception rather than the rule.

Most lines are broken by curious gaps which may be small and insignificant, or broad and striking. It is commonly assumed that these various gaps are due to our lack of knowledge of the animals concerned, and especially of their fossil record.

No doubt in very many cases this is true, but in most cases these gaps probably are real and never were bridged by so-called "missing links."

In the light of our present knowledge we can not doubt that all living things are the children of other living things, and that life has been continuous from parent to child from its earliest beginnings. How is it possible to harmonize this fact with the occurrence of broad and unbridged gaps in the evolutionary lines?

The answer is that continuity of life does nor necessarily imply continuity of the bodily form in which that life is manifested. In other words, children may be very different from their parents. As an illustration of continuity of life coupled with abrupt and striking discontinuity of form and also in mental traits, let us consider the dogs.

According to the best authorities all of the nearly two hundred different breeds of domesticated dogs are descended from a single type of ancestor, which was a wolf closely resembling our native wolf but

with slightly different teeth. The domestic dogs may be grouped, following Gibson, into wolf-dogs, greyhounds, spaniels, hounds, mastiffs and terriers.

Some of the wolf-dogs, as the dogs of the Esquimaux and of the Kamchadales, show a more or less close resemblance to wolves, while others, as the collies, Newfoundlands and St. Bernards, are much less wolf-like. But the wolf-dogs may be arranged in a fairly continuous series from the most to the least wolf-like.

This series of dog forms is parallel to many of the evolutionary lines which are seen in the geological history of the mammals, as for instance in the horses and hyænas. It is a series of types which differ only very slightly from each other running between two extremes which are widely different.

Of the other breeds of dogs we may select the greyhounds, hounds, bull-dogs and pugs—the last two from the mastiff stock—as representative types known to every one.

It is not necessary here to describe the diverse bodily forms of these well known breeds of dogs. But their mental traits call for brief consideration. The greyhounds, or as they are sometimes called the "gaze-hounds," have deficient powers of scent but unusually keen eyes and ears. They hunt entirely by sight. There are many different forms of greyhounds. The hounds, having poor sight, hunt by scent, and they are also divided into many different forms. Bull-dogs are deficient both in sight and scent and are stupid and ferocious, displaying little affection. Pugs, which are much like bull-dogs and are equally stupid, differ markedly from them in being timid and affectionate.

There are no intergrading types between the greyhounds, the hounds, the bull-dogs and the pugs, and there are no intergrades between any of these and wolves. If we did not know their ancestry we would never suspect that these types of dogs had anything to do with wolves. They furnish an excellent and obvious illustration of unbroken continuity of descent coupled with abrupt and wide changes in form and in mental attributes.

An understanding and appreciation of the conditions found among the dogs enables us to approach the problem of the relationship of man to the animal world.

Structurally and anatomically man is very close to the man-like or anthropoid apes. This is a readily demonstrable fact which is quite beyond dispute. But it is also beyond dispute that there is a sharp, clean-cut, and very marked difference between man and the apes.

Every bone in the body of a man is at once distinguishable from the corresponding bone in the body of any of the apes.

Furthermore, man differs very widely from the apes in the possession of articulate speech which enables him to accumulate knowledge in successive generations. He also differs in his use of fire and in his use of tools which, as is shown by the fossil record, have been human attributes from the very first. Besides this, so far as history and the study of modern races enables us to judge, he differs in his use of clothing and of ornaments.

The most important difference, however, is correlated with the fact that in man the ministrations of both parents are necessary in the raising of a family. A woman can not raise a family unaided. Interdependent with this we find in man a socially effective sentiment of love which creates and makes a unit of the family.

That family life was from the first a fundamental human institution would seem to be shown conclusively by the existence in all human races of taboos and laws directed toward the maintenance of the family. Taboos and laws are not, so far as we know, invented to mold society into new and preconceived forms, but on the contrary to correct evils recognized as possessing disruptive or destructive tendencies which from time to time appear.

All monkeys, so far as we know, live together in promiscuous hordes or troupes in which each female raises her own young unaided. Family attachments are not necessary and do not occur.

While man obviously belongs to the same division of the mammals as the apes, yet the differences between man and the apes seem to be too great ever to have been bridged by intermediate types. Of all the numerous fossils that have been found not a single one represents indubitably a "missing link."

Man appeared suddenly as a collateral line from the same general complex as the apes, but there is no evidence that he was ever one of them. Between man and the apes there is a gap, structural and psychological, of the same general nature as that, for instance, between the greyhounds and the bull-dogs. But while we know that the greyhounds and the bull-dogs are both descended from a wolf, a creature widely different physically and mentally from both types, we have no definite clue to the immediate ancestry of man.

The general features of human structure and anatomy were inherited, in accordance with the unbroken continuity of descent from parent to child, from some unknown ancestor common to all the

Primates, but so far as we have been able to discover not through an ape as we understand that term. The details of man's structure and his mentality are his alone.

Unbroken continuity of descent coupled with abrupt discontinuities or changes in bodily form is a common, striking, and well known phenomenon in most types of animal life. We must accord it a proper place in any theory dealing with zoogenesis.

PRIMAGENESIS

The problem presented by the interrelationships between the phyla or major groups of animals has until recently seemed wholly incapable of a logical solution. It has always been the chief stumbling block in the path of all theories of evolution, for no theory of the development of animal forms is tenable that does not definitely allocate the phyla each in a definite relationship with all the others.

Smellie in 1790 expressed the evolutionary concept prevalent in his day when he wrote:

> In the chain of animals man is unquestionably the chief or capital link. . . . . From him all the other links descend by almost imperceptible gradations from man to the minutest animalcule.

In 1811 Professor Meckel expressed his doubts regarding the truth of this so far as concerns the lower animals. He said:

> From these lowest Vertebrata to the highest, and to the highest forms among these, the comparison between the embryonic condition of the higher animals and the adult states of the lower can be more completely and thoroughly instituted than if the survey is extended to the Invertebrata, inasmuch as the latter are in many respects constructed upon an altogether too dissimilar type; indeed they often differ from one another far more than the lowest vertebrate does from the highest mammal.

In the sixties of the last century when that great scholar, Charles Darwin, was the commanding figure in biological thought his most formidable opponent in this country, was the equally learned scholar and brilliant and magnetic leader, Louis Agassiz.

Professor Agassiz' reputation has suffered in no small degree because of his outspoken opposition to Darwin's ideas on the subject of evolution. Yet his opposition is easily understood. While Darwin had an unusually extensive knowledge of the invertebrates, still his work in so far as it concerned evolution was the outcome of an exceptionally detailed knowledge of and intimate acquaintance with land inhabiting vertebrates.

Agassiz, on the other hand, had devoted his attention especially to invertebrates, including their larval stages, and to fishes. Among the invertebrate groups Darwinian evolution can not be made to apply, and it is scarcely more applicable to fishes. Agassiz realized this just as had Meckel fifty years before, and it is greatly to his credit that he was brave enough to uphold his convictions in the face of the strong tide of popular sentiment. But unfortunately neither he nor Meckel had any alternative hypothesis to offer.

The first clue to the true state of affairs was given through the discovery by the late Dr. Charles D. Walcott in the Middle Cambrian rocks of British Columbia of what are probably the most remarkable fossils ever found.

Through these fossils the wholly unexpected and astounding fact was brought out that so long ago as Middle Cambrian time the interrelationships between the various animal phyla were just the same as they are today. In the Middle Cambrian crustaceans were crustaceans, echinoderms were echinoderms, chætognaths were chætognaths, and annelids were annelids quite as unmistakably as they are in the present seas.

Since there has been no change whatever in the interrelationships of the animal phyla or major groups over this long period of geological history, why should we not assume that these interrelationships were the same at the very first appearance of life?

Such an assumption is open to the criticism that, while the fossils in the Cambrian rocks are the first that are adequately known, yet it is undoubtedly true that the Cambrian is much nearer to the present epoch than it was to the far distant time when life on earth began, so that conditions in the Cambrian are not necessarily those at the time of the origin of life.

The answer to this criticism is that since we know that the interrelationships between the phyla run back without any change whatever to the Cambrian, it is more logical to assume a continuation of these parallel interrelationships into the indefinite past than it is to assume, somewhere in the unknown pre-Cambrian ages, a change in the interrelationships, for which last assumption we have not the slightest evidence.

Since there is nothing to be learned bearing on the interrelationships of the phyla or major groups from a study of the fossils, we must rely on the data furnished by the study of embryology in order to solve this problem.

All animals living at the present time develop from a single cell. As this is true of every animal of which the development is known, we have no hesitation in assuming that it has always been true of every animal type. But this does not mean we must assume that the first animals to appear were all composed of single cells.

A single cell may divide in such a way that the two derivative cells are completely separated and drift or swim away independently of each other. This type of cell division, resulting in the complete separation of the derivative cells after each division, may continue indefinitely.

In the single-celled animals or protozoans this is what actually happens. A fully grown protozoan with a body consisting of a single cell divides into two independent animals, each with a body which in bulk is equal to half that of the parent. When these two reach full size they each divide into two in the same way, and the process is continued indefinitely.

But on the other hand a single cell may divide and after division the two resultant cells may remain in contact. Subsequent division after the same fashion will result in the formation of a mass of cells.

The question naturally arises, were the earliest animals composed of single cells, or were they composed of masses of cells, or did unicellular and multicellular animal types live together side by side as they do today?

It is commonly assumed that single-celled animals preceded the multicellular types in appearance. But can anyone give any reason for this assumption beyond the fact that in arithmetic—which is not zoology—the number one precedes the other numbers?

There is no basis whatever for assuming that complete separation of dividing cells is more primitive than adhesion of cells after division, or that it preceded adhesion. In fact, the great rarity of complete separation of cells after division in the animal world taken as a whole almost suggests that adhesion, not separation, is the primitive condition. Therefore the statement commonly made that the single celled animals or protozoans are the most primitive of the animals and preceded the multicellular types has nothing to support it. The only logical assumption, based on known facts, is that the appearance of unicellular and multicellular animal types was simultaneous—perhaps even that the latter appeared first.

Cells which after division remain in contact may adhere irregularly, resulting in the formation of a more or less unorganized mass. Such a

condition is characteristic of the great group of sponges in which many of the constituent cells are almost wholly independent of each other and suggest masses of protozoans packed closely together.

Cells which after division remain in contact may adhere regularly, resulting in the appearance of a series of geometrical forms. Regular division of cells followed by regular adhesion leads to the formation of a hollow ball of cells called a blastula. The blastula collapses, like a rubber ball with one side pushed in, into a cup with an outer and an inner layer of cells called a gastrula. The typical gastrula has an axis passing through the center of the opening and of the opposite pole, and the radii about this axis are everywhere the same—in other words the typical gastrula is radially symmetrical about its only axis.

If the radially symmetrical gastrula should become adult, there would result a radially symmetrical animal composed of two layers of cells of quite the same nature as a hydra or a sea-anemone.

The whole group of the Cœlenterata—hydras, corals, sea-anemones, sea-pens, hydroids, alcyonarians, gorgonians, antipatharians, jelly-fishes, and numerous other types—represent animals derived from a single cell through regular geometrical division.

As there is no reason to assume that irregular adhesion of cells necessarily preceded regular division and adhesion, there are no grounds for supposing that the cœlenterates are not as old as the sponges or the protozoans. The appearance of the protozoans, the sponges and the cœlenterates was presumably simultaneous. There is not the slightest evidence which would lead us to suppose that any one of these preceded any of the others. Each is the logical end product of a special type of cell division.

All other animals are always in some stage, and usually in the adult, bilaterally symmetrical with a more or less well marked head end at which are the main nervous centers, the chief sense organs, and the mouth. No matter how different they may be, all of these animals in the course of their development pass through a gastrula or comparable stage. This gastrula stage is the last stage common to them all, and following this stage they diverge in various directions. But since they all pass through a gastrula stage they are all reducible to the developmental line which, followed to its logical end, leads to the cœlenterates.

The key to the connection between the radially and the bilaterally symmetrical animals is furnished by four curious groups having a symmetry which is in part radial and in part bilateral. These four

groups consist of (1) types which by continuous budding produce a linear colony; (2) types in which the budding takes place internally within the original unit; (3) types which are solitary, each individual representing a dissociated cœlenterate unit; and (4) types which are colonial, though the individuals are independent of each other.

Between every two of these types there is another type which combines the characters of the one on either side, but shows no trace of radial symmetry. Thus between the types which by continuous budding produce a linear colony and the types in which the budding takes place internally we find a type which is segmented externally and also possesses internal budding (cœlomic budding); between the types in which the budding takes placed internally within the original unit and the types which are solitary, each individual representing a dissociated cœlenterate unit, we find a type which is solitary with internal budding, but no segmentation, and so on.

On the basis of their fundamental characters all of the animal phyla or major groups may be arranged in five successive series of four each, the outermost four being the four partially radial types mentioned. Such a figure shows each phylum as related more or less equally to four others, and more distantly to all the rest. As we pass from the outer to the inner series we find that the phyla become more and more complex, and also progessively less and less widely differentiated from each other.

The exact center of the figure is occupied by the vertebrates which combine the characters of the four groups immediately surrounding them (cephalochordates, balanoglossids, pterobranchiates and tunicates) but are not more closely related to any one of these than to the other three.

The details of this arrangment are very complicated and can not be described except in technical terms. For these details the reader is referred to the author's paper on *The origin of the vertebrates.*[2]

According to this interpretation the various phyla of bilaterally symmetrical animals are in effect recombinations of features which are inherent in animals taken as a whole, or in other words recrystallizations of the fundamental animal features which occur at every focal point where an animal type capable of existence may be reconstructed from the elements available in the general animal complex.

No appreciable time element is necessarily involved in such a process of recombination or recrystallization of fundamental animal features,

[2] This JOURNAL **13**: 129–138. 1923.

so that at the very first appearance of life the animal world, so far as the phyla or major groups are concerned, probably was quite the same as it is today.

The figure formed by this recombination of elemental structural features into the various phyla represents the basic structure in which all of the evolutionary trees are rooted and from which they rise, one from each phylum, upward through succeding ages.

This interpretation of the origin of the various phyla as resulting from recombinations of characters inherent in animals as a whole supplies the key to the very sharp distinctions usually to be seen between the different classes in each phylum. For the principle of recombination seems to explain such sharp distinctions or very broad mutations as those between the starfishes, brittle-stars, sea-urchins, sea-cucumbers, and crinoids and their allies in the echinoderms; between the gastropods, bivalves, scaphopods, cuttle-fish and other types in the mollusks; and between the crustaceans, insects, spiders, and other forms in the arthropods. Coming down to finer divisions, it serves to explain the curious isolation of the skippers (Hesperioidea) in the Lepidoptera, and in the skippers the sharp difference between the megathymids and the other types.

SUMMARY

The picture which we get of the development of the animal world—of zoogenesis—from the preceding exposition and interpretation of the facts is that at the very first all of the numerous phyla came into being not successively but simultaneously by following different paths of development from the single cell. The process leading to the original appearance of the phyla—primagenesis—gives a result that at first sight appears to be creationism, though in reality it is very different.

Each of the phyla represents a recombination of characters inherent in animals as a whole in a form capable of meeting the requirements of animal existence, both in internal balance and in external contacts.

Apparently the focal points at which a balanced condition capable of survival and of meeting competition is attainable are rather few and are well separated from each other, for each of the phyla is widely different from all the rest.

The flat picture of animal life presented as the result of primagenesis serves as the ground from which various evolutionary trees, one for each phylum, rise upward through geologic time.

The larger phyla are divided into classes, and as a rule these classes are quite distinct each from the other and do not intergrade. Thus

in the mollusks we find pelecypods, scaphopods, solenogasters, gastropods and cephalopods; in the echinoderms there are starfishes, brittle-stars, sea-urchins, sea-cucumbers, crinoids, cystids and blastoids; and in the arthropods there are crustaceans, arachnids, myriopods and insects.

The distinctness of these classes each from the other probably is of the same nature as the much broader distinctions between the various phyla. That is, each class should be interpreted as a recombination within the phylum in every economically possible form of characters inherent in the phylum.

Within the classes the same phenomenon is again repeated in the different orders, as is especially well seen in the insects, crustaceans, mollusks and echinoderms. Abrupt discontinuities may be followed further into sub-orders, families, genera and species, in the last being evidenced by the so-called mutations.

It should perhaps be emphasized that discontinuities are much less marked within the phylum Vertebrata than they are in the large invertebrate phyla. But the entire structural range in all the vertebrates taken together is scarcely greater than that in certain single species of insects or crustaceans in different stages in their life history. The vertebrates possess such a delicately balanced complexity of internal structure, and as a result of their large size such a delicate adjustment to their environment, that variations brought about by a continuous series of slight changes and progressive minor readjustments are more suited to them than the sudden wide and abrupt discontinuities so frequent in invertebrate types.

Among the vertebrates well marked evolutionary lines are frequent and wide discontinuities are relatively rare; but the reverse is true in all the other phyla of comparable size.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE GEOLOGICAL SOCIETY

446TH MEETING

The 446th meeting of the Society was held at the Cosmos Club, January 9, 1929, President CAPPS presiding.

Program: W. H. BRADLEY: *Varves and the duration of the Eocene epoch.*

ANNA I. JONAS: *Structure of the metamorphic belt of the central Appalachians.* The metamorphic folded belt of the Appalachians in the area from eastern Pennsylvania to North Carolina consists of a southeastern or Martic overthrust block lying west of the Coastal Plain sediments and, on the north-

west, the anticlinal uplifts and synclinal infolds of the Highland-Blue Ridge anticlinorium, bounded on the west by the Great Valley.

Both divisions are made up of closely folded rocks of pre-Cambrian and Paleozoic age that are broken by thrust faults, showing all gradations from broken recumbent anticlines to clean cut thrusts developed from them and low angle thrusts of the Scottish Highland type. The thrusts of the anticlinorium belong to the former, while the Martic thrust belongs to the latter class. The Martic thrust fault bounds a block of the earth's crust whose eastern part is covered by Coastal Plain sediments. Its linear extent has been traced from the edge of these sediments in eastern Pennsylvania southwest into North Carolina.

The great width of the Martic overthrust block in southern Virginia is in part due to the southeast curve of Coastal Plain sediments and to the southwest direction of normal Triassic faults that form its northwestern border throughout most of Virginia, as well as the westward advance of the overthrust mass. The southwest direction of Triassic faults transverse to the folds of the anticlinorium on the uplifted side of the normal faults have had the effect of cutting them off from east to west and of decreasing the width of this belt.

The Martic overthrust is of post-Ordovician age and may be as late as post-Mississippian or post-Pennsylvanian, corresponding in age to the thrusts in and west of the anticlinorium. It is cut by little-deformed granites that are absent in Pennsylvania and occur in small areas in Maryland. They are widespread only southwest of Central Virginia. They have true granitic texture and lack the metamorphism of the pre-Cambrian granoblastic igneous rocks. They cut only pre-Cambrian crystalline schists and intrusive relations give no positive evidence of their age. They may be epi-Ordovician or post-Carboniferous in age. The absence of definite proof of the post-Permian age of these granites and lack of their wide distribution in many parts of the area throw doubt on the hypothesis that they produced the force for Appalachian deformation. (*Author's Abstract.*)

H. S. Washington: *Bearing of the rocks of the Island of St. Paul on the structure of the Atlantic floor.*

447th meeting

The 447th meeting was held at the Cosmos Club January 23, 1929, President Capps presiding.

Program: Frank Wenner: *Development of seismometry for recording distant earthquakes.*

A. L. Day: *The activities of the Carnegie Institution in seismology.*

L. H. Adams: *The structure of the earth's crust as revealed by seismologic observations.*

448th meeting

The 448th meeting was held at the Cosmos Club February 13, 1929, President Capps presiding.

Program: A. C. Spencer: *Geology of Santa Rita, New Mexico.*

W. B. Lang: *Subnormal temperature gradients in the Permian basin of Texas and New Mexico.* The first deep well temperature test made in the Permian Basin of Texas and New Mexico near the southeastern border indicated a normal gradient. Later (1923) it was noted that oil-well tests being

drilled in the Basin were running cool and that low gradients were to be expected. The first instrumental proof of this fact was demonstrated in 1925, and in 1926 a gradient in excess of one degree Fahrenheit for every 250 feet of descent was obtained in Ward County, Texas. Other tests in West Texas and southeastern New Mexico in the Basin continue to show low gradients, and it is believed this condition extends westward beyond the saline boundary. Also the Panhandle of Texas and western Oklahoma are known to run cool and some temperatures in Iowa subnormal. In contradistinction, the Bend Arch to the east of the Basin is warm and to the west of the Central Mineral Region normal.

From an average of worldwide observations temperature gradients of 60 to 70 feet per degree Fahrenheit are considered normal. Lower gradients may therefore be considered as subnormal and dependent on abnormal influences. The present normal gradient is, to a degree, an arbitrary figure and subject to the influence of additional investigations properly spaced in accordance with the needs of the problem rather than of chance opportunity.

The Permian Basin is a region of sedimentary deposition in which halite and anhydrite play a prominent part, also potash. Theories accounting for the depression of the isogeotherms depend on sedimentation or structural deformation; paleoclimatic conditions; radioactivity (β ray of potassium); chemical change—anhydrite-gypsum, secondary mineral changes, solution reactions, etc.; radiation and heat conduction (halite); degrees of rock saturation, etc., seem to be inadequate to a satisfactory explanation. There is need for further reliable temperature measurements in order to outline the subnormal area and to assign proper values to the factors that may have causal relationship. Continued temperature measurements are in progress with this end in view. (*Author's Abstract.*)

JAMES GILLULY: *A possible capture of one desert basin by another.* The geographic and hypsometric relations of Rush Valley and Tooele Valley, Utah, together with the peculiar three stage dissection of Soldier Creek fan while all the other fans of the valley show but two stages of dissection, are interpreted as consistent with pre-Bonneville integration of the drainage of Rush Valley with that of Tooele Valley. The peculiar channel form of Rush Lake and its position between two of the largest fans in Rush Valley are anomalies which are explicable on this hypothesis. Climatic fluctuations or Bonneville wave erosion are shown to be impossible alternatives to this hypothesis, and although earth movements could be conceived which would explain the observed features, they are considered improbable.

It is concluded that drainage integration between separate basins may well occur without access to the sea. (*Author's abstract.*)

449TH MEETING

The 449th meeting was held in the Assembly Hall of the Cosmos Club February 27, 1929, President CAPPS presiding.

Program: Prof. RICHARD M. FIELD, of Princeton University: *Observations on the geological history of Yellowstone Park.* Paper published in full in Am. Journ. Sci. (17) 99. March, 1929.

C. S. ROSS: *Origin of the magnetite and associated rocks of Cranberry, N. C.* The Cranberry iron mine lies in Avery County, in western North Carolina, near the southwest border of the Cranberry folio and on the lower flank of a spur of Roan Mountain. The inclosing rock is the Cranberry granite of pre-Cambrian age.

The ore zone is made up of gneissoid rock composed of magnetite, hornblende, epidote, and other ferromagnesian minerals. This is cut by a pegmatite complex that branches and reunites in an intricate manner. The ores appear to have been formed in two stages. The first produced lean magnetite gneisses. Later these were intruded by pegmatite of normal composition, i.e., microcline and quartz. This pegmatite was first invaded and partly replaced by albite and quartz forming solutions and then by ferro-magnesian solutions that introduced first epidotized feldspar, hornblende, hedenbergite and finally magnetite. At the same time the lean magnetite gneisses were further enriched by magnetite and the commercial ores produced. At a later stage a very small amount of sulphides were introduced and calcite formed.

A. A. Baker and J. B. Reeside, Jr.: *Some features of Permian sedimentation in northern Arizona and southern Utah.* In San Juan Valley and a zone north and south from it the Permian begins with a unit of interbedded marine limestone and red beds, followed by several alternations of red beds and thick, light-colored, cross-bedded sandstones. Various names have been applied. Eastward these units pass into a similar basal unit and a thick series of arkosic red beds, called Rico and Cutler formations, respectively. Westward the units pass into the formations constituting the Grand Canyon section—Supai red beds, Hermit red beds, Coconino sandstone, and Kaibab limestone. Still farther westward few or no red rocks are present. The red beds seem to have been derived chiefly from the east. The light-colored sandstones seem to have come from both northwest and southeast. Kaibab limestone is thickest in the west and fades into sandstone eastward. Over much of the region the Permian is underlain conformably by Pennsylvanian limestone and is overlain uncomformably by Lower Triassic beds. (*Author's abstract.*)

A. A. Baker and James Gilluly, *Secretaries.*

SCIENTIFIC NOTES AND NEWS

Mr. Neil M. Judd, Curator of American Archeology, U. S. National Museum, left Washington in mid-May to join Doctor A. E. Douglass, of the University of Arizona, and Mr. Lyndon Hargrave, at Flagstaff, on an archeological reconnaissance of central Arizona in search of ruins from which burned timbers might be recovered. The Museum of Northern Arizona, at Flagstaff, Doctor Harold S. Colton, Director, is coöperating by loaning Mr. Hargrave, who assisted Doctor Douglass in earlier beam studies at Hopi villages and elsewhere in Arizona. The purpose of the present expedition, under the auspices of the National Geographic Society, is to bridge the single remaining gap in the tree ring chronology now being erected by Doctor Douglass and by means of which most pre-Spanish ruins of the Southwest can be absolutely dated. This season's investigations are in continuation of those conducted for the Society by Mr. Judd at Pueblo Bonito, New Mexico, during the years 1920–1927.

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PALEONTOLOGY.—*Shorter contributions to the paleontology of the Eocene of northwestern Peru: I, Solitary corals. II, Brachiopods. III, Foraminifer* Gypsina.[1] WILLARD BERRY, Johns Hopkins University. (Communicated by JOHN B. REESIDE, JR.)

I, Solitary Corals

It has been my good fortune to find two species of solitary corals belonging to the genera *Flabellum* and *Balanophyllia* in a grayish-brown gritty, calcareous sandstone near Calita Sal, Department of Piura, Peru. Though these corals are not well enough preserved to deserve a specific name they are worthy of record as an interesting part of the fauna. I have correlated the sandstone with the Eocene (probably upper Eocene) Saman conglomerate[2] because of the occurrence with the corals of the brachiopod *Liothyrina peruviana* Olsson and the foraminifera *Orthophragmina* (*Discocylina*) *peruviana* Cushman, *O.* (*D.*) *salensis* W. Berry, *O.* (*Asteriacites*) *calita* W. Berry, and *O.* (*Asterodiscocylina*) *stewarti* W. Berry.

It is interesting to note in the Eocene of this area the occurrence of solitary corals associated with the larger foraminifera and a brachiopod, all forms usually considered indicative of fairly clear water. The matrix is rather coarse, the grains attaining a maximum diameter of 1 mm. There is, however, little evidence of sorting, for considerable fine silt or mud is present in the sediments. Some of the cement is calcareous and some of the specimens of *Liothyrina peruviana* are now geodes partly filled with calcite crystals.

[1] Received April 13, 1929.

[2] A. Iddings and A. A. Olsson. *Geology of northwestern Peru.* Am. Assoc. Petr. Geol. Bull. **12**: 17. 1928.

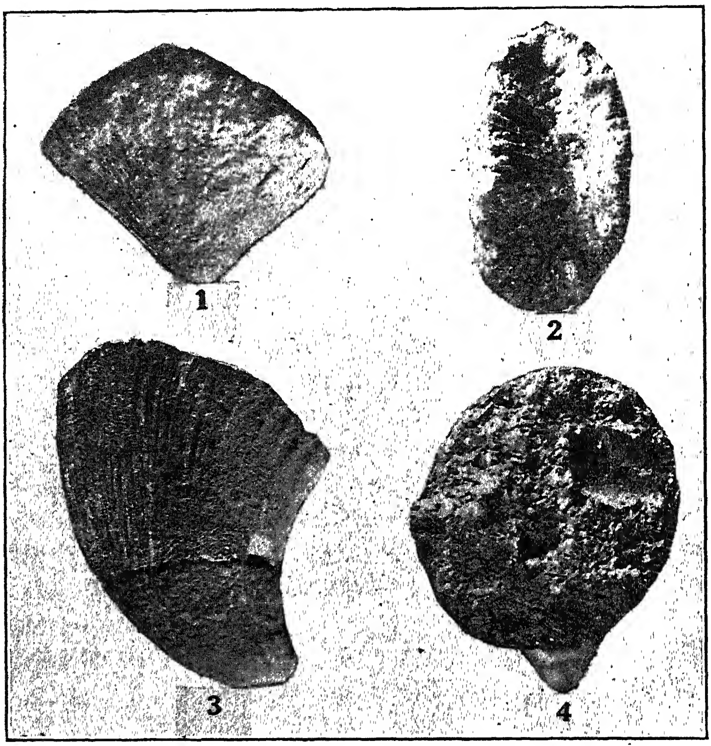
A. A. Olsson. *Contributions to the Tertiary paleontology of northern Peru, pt. 1, Eocene Mollusca and Brachiopoda.* Bull. Am. Paleont. **14** (52). 1928.

The two corals may be described as follows:

FLABELLUM SP. (Figs. 1, 2)

Corallum attached by a very short pedicle; shape cuneate, compressed; no evidence of wing-like processes, nor of growth lines encircling the corallum. Costae well developed but fine. Septa not clearly shown, as the entire central portion of the corallum is obscured by matrix.

Greatest diameter, 14 mm.: least diameter, 8 mm.; height of corallum, 12 mm.



Figs. 1, 2.—*Flabellum* sp., × 3
Figs. 3, 4.—*Balanophyllia* sp., × 3

Locality: Near Calita Sal, Department of Piura, Peru.
Horizon: Saman conglomerate, Eocene.

I have not given this specimen a specific name because of the lack of knowledge of the septa. In external appearance it may be compared with *F. cuneiforme* var. *wailesi* Conrad, of the Jackson and Vicksburg formations in the Gulf Coastal Plain of the United States. However, the fossil presents so few of the internal features that comparisons are of small value.

BALANOPHYLLIA SP. (Figs. 3, 4)

Corallum elongate, cornute, curved in the plane of the longer transverse axis of the corallum. Costae fine, low, every second one more acute and larger

than the intervening one. Area of attachment small. Septa almost entirely obscured by matrix.

Greatest diameter, 14 mm.; least diameter, 12 mm.; height of corallum, 16 mm.

Locality: Near Calita Sal, Department of Piura, Peru.

Horizon: Saman conglomerate, Eocene.

I have not given this specimen a specific name because of lack of information concerning the interior characters. It may be compared with *B. irrorata* (Conrad) in the external features, but such a comparison has little meaning.

II, Brachiopods

The gritty, brown sandstone near Calita Sal, Department of Piura, Peru, has yielded four species of Brachiopoda, three of which appear to be new. The fourth is a species described originally by Olsson as *Liothyrina peruviana* Olsson from the Saman conglomerate, probably early upper Eocene.[3] With the Brachiopoda I found *Nummulites speciosa* W. Berry, originally described from the Saman conglomerate at Negritos, Peru, 50 miles south of Calita Sal, and several species of *Orthophragmina,* also originally described from the Saman conglomerate.

Nowhere else in the extremely thick series of Tertiary sediments found in northern Peru, so far as I know, are any brachiopods or *Orthophragmina* found. In the overlying beds are found many orbitoids, but these all belong to the large genus *Lepidocyclina* and its subgenera.

The new Brachiopoda may be described as follows:

Terebratulina peruviana W. Berry, n. sp.

Figs. 1–4

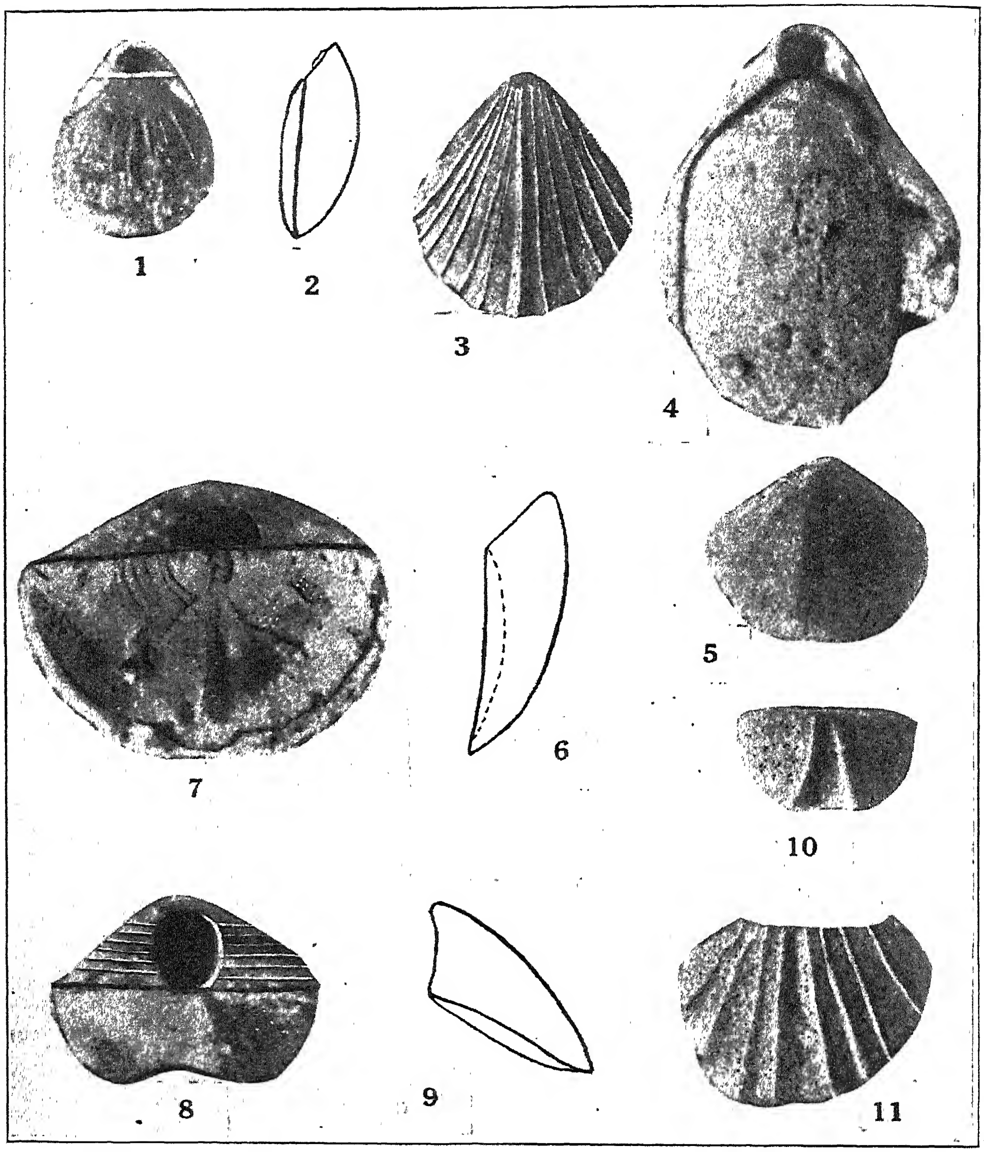
Shell extremely minute, ovate, biconvex, rectimarginate; cardinal extremities slightly auriculate; test capillate, finely punctate. Beak suberect. Foramen large, nearly circular, submesothyrid; deltidial plates disjunct; pedicle collar short. Crura relatively long (poorly preserved), crural process united by a fairly broad ribbon, making the loop into a ring. There is no septum in the dorsal valve.

Length: 1 to 4 mm.; *width:* 1.25 to 3.5 mm.; *thickness:* 1 mm.

T. peruviana is somewhat like *T. pectinoides* v. Koenen, described from the middle Oligocene of Germany,[4] but differs in the shape and size of the deltidial plates and in the relative abundance of the ribs. It is here given specific rank despite its small size, because if it were the young of a larger form there should certainly be found some of the adult specimens. The only larger brachiopod found in the formation belongs to another genus.

[3] A. A. Olsson. *Contributions to the Tertiary paleontology of northern Peru. Pt. 1. Eocene Mollusca and Brachiopoda.* Bull. Am. Paleont. **14** (52). 1928.

[4] Abh. Geol. Specialkarte Preussen **10** (6). 1894.



Figs. 1–4.—*Terebratulina peruviana* W. Berry, n. sp. Dorsal aspect; 2, profile; 3, ventral aspect; 4, dorsal aspect of a very large specimen.

Figs. 5–9.—*Argyrotheca peruviana* W. Berry, n. sp. 5, Ventral aspect; 6, profile; 7, dorsal aspect; 8, view of cardinal area; 9, profile of Fig. 8.

Figs. 10–11.—*Argyrotheca chica* W. Berry, n. sp. 10, Dorsal aspect; 11, ventral aspect.

All figures × 12½

Argyrotheca chica W. Berry, n. sp.
Figs. 10, 11

Shell minute, subrectangular to broadly oval; cardinal margin megathyrid; valves biconvex, nearly smooth, the median line of both valves being occupied by a sulcus on either side of which is one wide plication punctations rather fine, very noticeable; growth lines show faintly. Rostrum short, subtruncate. Foramen large, almost hypothyrid, incomplete; deltidial plates small, trigonal; pedicle collar well developed and supported by a heavy median septum which extends forward nearly to the middle of the valve. Crura widely separated, loop long (very poorly preserved).

Length: 2–3 mm.; *width:* 3–4 mm.; *thickness:* 1.5–2 mm.

This species differs from the following in having fewer plicae, more variable size of shell, and better development of the growth lines. I have concluded that it is a distinct species because no larger specimens of the same genus are found in the area.

Argyrotheca peruviana W. Berry, n. sp.
Figs. 5–9

Shell minute, subrectangular to transversely pentagonal; cardinal margin megathyrid; valves biconvex, multiplicate, the median line of both valves being occupied by a sulcus on either sides of which there are five rounded plicae, those of the ventral side being better developed then those of the dorsal side; punctations rather fine, very noticable. Rostrum short, subtruncate. Foramen very large, submesothyrid, incomplete; deltidial plates small, trigonal; pedicle collar well developed and supported by a median septum which extends nearly to or even a little beyond, the middle of the valve.

Length: 2 mm.; *width:* 3 mm.; *thickness:* 1.5 mm.

A. peruviana is somewhat like *A. beecheri* (Clark), described from beds at Vincentown, New Jersey, long assigned to the Cretaceous but recently placed in the Eocene. *A. peruviana* is smaller, has fewer plicae and much finer punctations than *A. beecheri.*

This is the first record of the genus in the Tertiary of South America and it is interesting to note that it is found most abundantly in the European Tertiary. There are about eleven species from North America and about thirty from Europe.

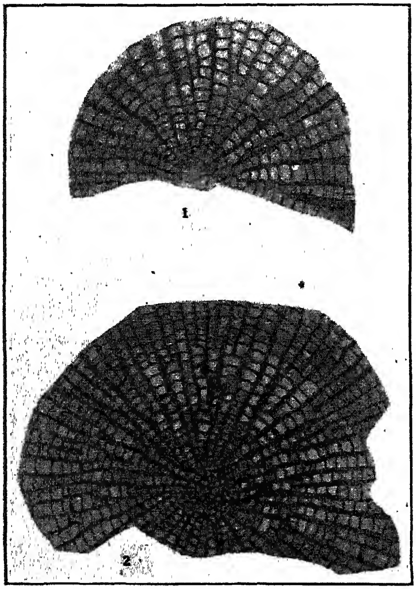
III, Foraminifer Gypsina

During some years work on the Tertiary section of northern Peru I found twelve specimens of a single species of *Gypsina.* The genus, originally a part of *Tinoporus* (Monfort?) Carpenter and later separated by Carter, contains about a dozen species rather widely scattered geographically. It is found in the present-day seas, usually in the shallow zones of both temperate and tropical areas and, according to Brady, seldom below 400 fathoms. Cushman[5] gives the range

[5] J. A. Cushman. *Foraminifera, their classification and economic use,* p. 330, 1928.

of *Gypsina* as Cretaceous to Recent. I have not been able, however, to find any record which carries it beyond the Tertiary. The species *G. globulus* (Reuss) has been described from the Miocene of Austria, Hungary, Malta, and Jamaica; from the Pliocene of Costa Rica; and the "Tertiary" of Palermo, Bordeaux, and San Domingo. The genus has been considered a chiefly Miocene group and hence it is of interest to describe a species from the Eocene. My material is from the gray-brown, gritty sandstone at a locality near Calita Sal, Department of Piura, Peru, and is associated with both large and small fossils typical of the Saman conglomerate.

The new species may be described as follows:



Figs. 1, 2.—*Gypsina peruviana* W. Berry, n. sp. 1, Cross section of large specimen, × 35. 2, Cross section of small specimen, × 35.

Gypsina peruviana W. Berry, n. sp.
(Figs. 1, 2)

Test small, spherical, apparently free; exterior reticulate surface-chambers opening directly to the outside; walls calcareous. Chambers arranged in radial columns, increasing in diameter from the center to the periphery. In the center the chambers are 19.5 microns in radial diameter and as much in cross section, with walls 8 microns thick; and they increase in size to 46 microns in radial diameter and 66 microns in cross section, with walls 15 microns thick, at the periphery of the averaged-size test. These radial columns of chambers each divide into two at about 156 microns from the center, at 234 microns, and again at 390 microns.

Diameter of test 0.9 to 1.67 mm.

G. peruviana may be compared to *G. globulus* (Reuss) in size and in general character of the surface. The interior features, however, are distinctive, particularly the bifurcation of the columns of chambers. In none of the described forms is such a feature mentioned. The division produces a greater number of chambers in a given circle than would be present if the columns did not divide but continued to increase in size enough to maintain the spherical form of the test.

PALEONTOLOGY.—*Notes on the ammonite genus* Karstenia *Hyatt.*[1]
ERNEST C. H. ROSCHEN, Johns Hopkins University. (Communicated by JOHN B. REESIDE, JR.)

The genus *Karstenia* was proposed by Hyatt[2] in 1903 (as *Carstenia*) with *Ammonites lindigi* Karsten as genotype. In a revision of the old genus *Pulchellia,* Hyatt recognized two families, the *Heinziidae,* including the genus *Karstenia,* and the *Pulchelliidae.* The *Heinziidae* consisted of those forms in which the costae terminated at the venter in a single or double row of tubercles, elongated in the direction of coiling; and the *Pulchelliidae* included the highly compressed forms with a very narrow, or closed umbilicus. At that time Hyatt stated that the new genus, *Karstenia,* is characterized in the early stages of life by "coarse costae with double terminations becoming dichotomous at the middle lateral line and having a line of nodes at their junctions. These [nodes] are continued later on the single costae when these appear." The forms are stout, have a double row of outer tubercles close together on the ventral line, and the ventral furrow is narrow in young forms but later broadens and becomes similar to that of *Pulchellia* (= *Gerhardtia* Hyatt) *galeatoides* Karsten.. In addition to the genotype, Hyatt included in *Karstenia* the species *Pulchellia caicedi* (Karsten), *P. subcaicedi* Sayn, *P. galeata* (D'Orbigny, not Von Buch), and *P. provincialis* Gerhart (=*Karstenia tuberculata* Hyatt).

Douville[3] did not accept Hyatt's division of the *Pulchelliidae* into two families, nor did he consider Hyatt's new genus *Karstenia* to be of more than sub-generic importance. In a revision of the genus *Pulchellia* in 1920 Gignoux[4] also did not accept the genus *Karstenia* and placed Hyatt's genotype, *Pulchellia lindigi* (Karsten), in a subdivision of the *Pulchellia,* the group of *Pulchellia* s. s. (tuberculées Gignoux), characterized by *P. provincialis* (D'Orbigny). In 1924 Collet[5] described a group of ammonites from the Barremian of Colombia in which are strongly emphasized the characteristic differences

[1] Received April 13, 1929.

[2] A. HYATT. *Pseudoceratites of the Cretaceous.* U. S. Geol. Surv. Mon. 44: 133–134. 1903.

[3] H. DOUVILLÉ. *Evolution et classification des Pulchellidés.* Bull. Soc. géol. France **11** (4): 285–320. 1911.

[4] W. KILLIAN, M. GIGNOUX, and others. *Contributions à l'étude des céphalopodes paleocrétacés du Sud-Est de la France.* Mém. Carte géol. France, pp. 135–166. Paris, 1920.

[5] L. W. COLLET. *Sur quelques ammonites du Barrémian de Colombie.* Ecologae. Geol. Helvetiae **18**: 485–493. 1924.

in the growth of *Karstenia lindigi* (Karsten) as compared with representatives of true *Pulchellia.* He accepted Hyatt's genus *Karstenia* as valid.

This generic separation seems to be well founded, as the forms belonging to the genus *Karstenia* have stout whorls throughout their development and do not exhibit at any stage of growth the compressed whorls characteristic of the ontogeny of *Pulchellia.* As remarked by Collet, in the adult stages *Karstenia lindigi* (Karsten) converges toward *Pulchellia provincialis* and *P. galeatoides.*

During the examination of a collection of ammonites from Ubaté, Cundinamarca, Colombia, made by Dr. M. A. Rollot and presented by him to the U. S. National Museum, one well preserved specimen of *Karstenia lindigi* (Karsten) was found in which the ontogeny of the genus is admirably exhibited. The specimen presents an opportunity for a more thorough description than Collet gave, and since the validity of the genus has been doubted by most students of the *Pulchelliidae,* it has seemed worth while to record in detail the features exhibited by this specimen.

Karstenia lindigi (Karsten)

1856. *Ammonites lindigii* Karsten. Über die geognostischen Verhältnisse des westlichen Colombien, der heutigen Republiken Neu-Granada und Ecuador. Amt. Ber. Naturf. Gesell. Wien, 32te Vers., 1856: 108. *pl. 3, f. 3.*

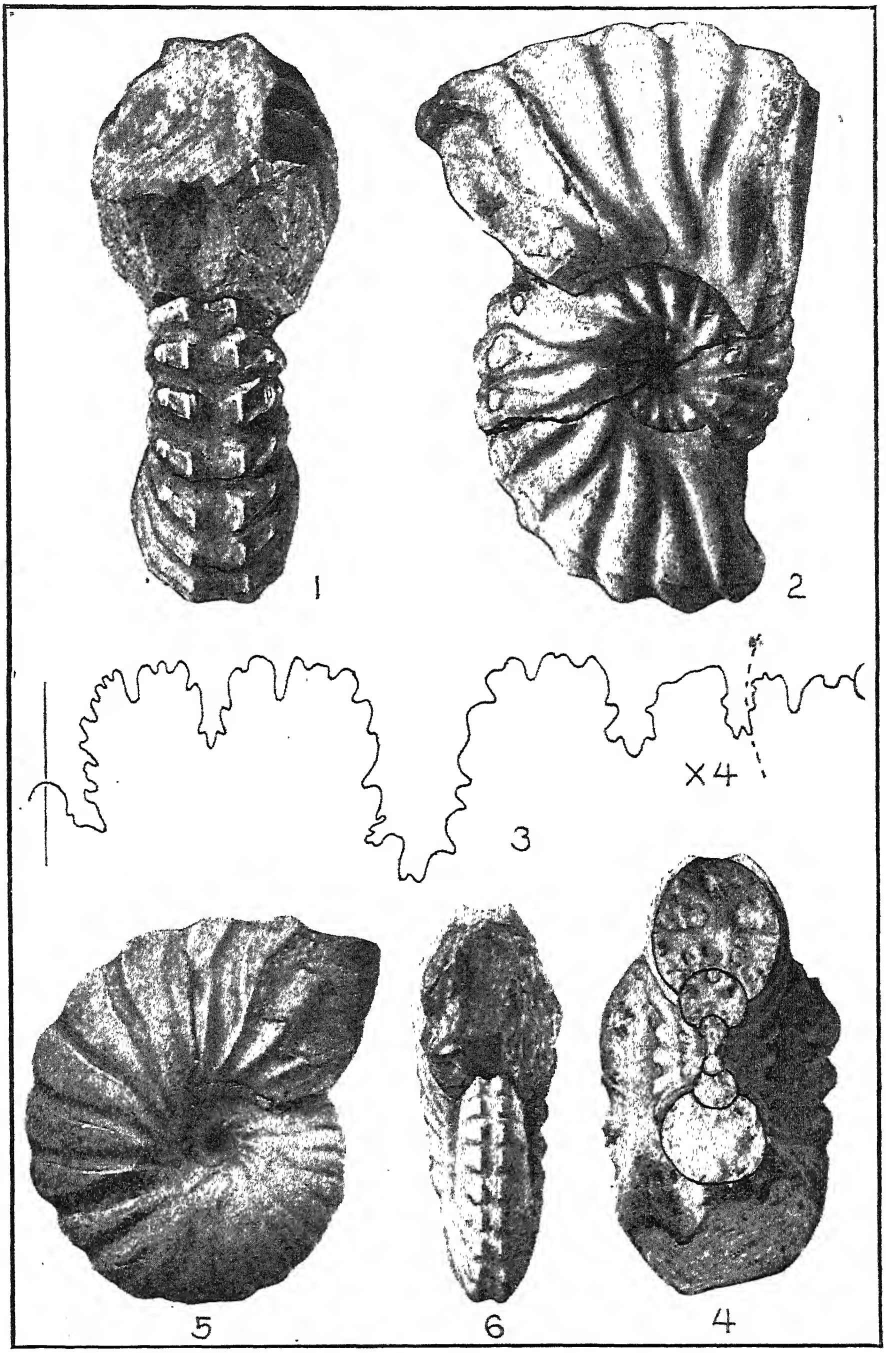
1883. *Pulchellia lindigi* (Karsten). V. Uhlig. Die Cephalopoden der Wernsdorfer Schichten. Denkschr. naturw. Classe. k. k. Akad. Wiss. **46**: 125. *pl. 20, f. 6.*

1886. *Ammonites lindigii* Karsten. H. Karsten. Géologie de l'ancienne Colombie Bolivarienne, Vénézuela, Nouvelle-Grenade et Ecuador. *Pl. 3, f. 3.* Berlin.

1903. *Carstenia lindigi* (Karsten). A. Hyatt. Pseudoceratities of the Cretaceous. U. S. Geol. Surv. Mon. **44**: 133–134.

1924. *Carstenia lindigi* (Karsten). L. W. Collet. Sur quelques ammonites du Barrémien de Colombie. Eclogae Geol. Helvetiae **18**: 488. *pl. 15, f. 1–6.* 1924.

Shell attaining a size of about 80 mm.; moderately involute; whorls stout and nephritic-subcircular in cross section; umbilicus wide and umbilical wall moderately steep, umbilical angle decreasing slightly in each successive whorl. Costae heavy and beginning at the umbilical margin, alternating with costae that arise on the sides slightly above the umbilical shoulder, the latter also rarely starting near the umbilical margin; both separated by deep intercostal furrows slightly narrower than the ribs; both possessing a double row of nodes on each side of the venter; lateral nodes flattened; ventral nodes prominent and elongated in the direction of coiling accompanied by rapid widening of the costae between the two rows of nodes; venter wide, ventral furrow channeling the costae and rarely the intercostal furrows also.



Figs. 1–4.—*Karstenia lindigi* (Karsten). U. S. N. M. cat. no. 73655
Figs. 5–6.—*Pulchellia galeata* (Von Buch). U. S. N. M. cat. no. 73656

At a diameter of 8 mm. the whorl height is about three-quarters of the width; at 12 mm. it is slightly less than equal; at 19 mm. it is equal, and thereafter gradually becomes slightly greater than the width. The dimensions are:

	mm.	mm.	mm.	mm.	mm.	mm.
Diameter:	8.0	12.0	19.0	29.0	44.0	76.0
Height of whorl:	3.7	6.3	9.0	13.5	20.0	31.5
Width of whorl:	4.5	6.5	9.0	13.0	18.0	28.5

At a diameter of 19 mm. the costae are seen beginning at the umbilical margin, they bifurcate on the sides slightly above the umbilical shoulder, the junction being marked by a prominent node. Every third rib does not bifurcate and does not possess a node near the umbilical shoulder. The ribs are prominent and separated by intercostal furrows of slightly greater width than the ribs themselves. The two rows of nodes at the venter are highly protuberant. At a diameter of 41 mm. the front branch of the dichotomous costae has become independent of the rear branch; one rib, generally derived from the front branch, beginning on the sides slightly above the umbilical shoulder and alternating with the other rib, starting at the umbilical margin. The ribs do not alternate on the two sides of the venter. The node at their junction has disappeared and is represented by an elongated prominence on the longer rib, this prominence gradually disappearing on the next whorl; the inner row of nodes at the ventor-lateral margin is still protuberant, the outer row has flattened appreciably, and the costae have become slightly wider than the intercostal furrows. At a diameter of 79 mm. the vestigal prominences at the point of bifurcation of the costae have disappeared entirely, the nodes of the outer ventral row have become highly flattened and the inner row is much less prominent. At this stage of growth the convergence of *Karstenia lindigi* toward *Pulchellia provincialis* and *P. galeatoides* is rather pronounced.

At a diameter of 43 mm. the suture is characterized by the presence of one siphonal lobe and two lateral lobes. The siphonal lobe is approximately three times as long as it is wide and is indented one-quarter of its length by a U-shaped siphonal saddle. The first lateral saddle is twice as broad as deep. It is divided by a prominent adventitious lobe into unequal halves, of which the inner is slightly larger and broader than the outer. Each half is further divided by one prominent small indentation, and several feebly developed indentations. The first lateral lobe is three times as long as wide, and the sides converge slightly from the base of the lobe to the blunt apex. The second lateral saddle is shallow, a little deeper than broad. The second lateral lobe is very small, about twice as long as wide and trifurcated. In addition there are three small auxiliary lobes and saddles with slightly indented outlines. The suture line, in general, is not deeply dissected.

Locality and horizon.—Barremian at Ubaté, Cundinamarca, Colombia. (U. S. N. M. Mesozoic locality no. 10537, M. A. Rollot collection.)

The form and ornamentation of the specimen described are very similar to those of the figured specimens of Karsten (pl. 3, fig. 3) and Collet (pl. 15, figs. 1–6). In Karsten's illustration the nodes at the point of bifurcation of the costae occur further out from the umbilical shoulder, at approximately

the middle lateral line. Karsten's illustration of *Ammonites caicedi* (pl. 3, fig. 2) would indicate that this species is closely related to *Karstenia lindigi.* It has a higher degree of involution than *Karstenia lindigi*, the ventral channel is wider, the outer row of ventral nodes is less pronounced in specimens of the same size, the nodes at the point of bifurcation of the costae are closer to the umbilicus, the costae are heavier and broader, and the whorl section is more compressed near the venter.

As previously remarked, the adult forms of *Karsenia lindigi* have the general appearance of *Pulchellia provincialis* and *P. galeatoides*. However, in these two species of the *Pulchellia* the ontogeny is characterized by the development at some stage of compressed whorls that become gradually stouter, whereas *Karstenia lindigi* is characterized by stout whorls that become slightly compressed in the mature individuals.

The morphological features of the specimes of *Karstenia lindigi* examined by the writer, as well as other specimens referred to the genus *Karstenia* by other writers, do not justify the alienation of Hyatt's family *Heinziidae* from the family of the *Pulchelliidae.*

BOTANY.—*A singular new* Dryopteris *from Colombia.*[1] WILLIAM R. MAXON, U. S. National Museum.

In the course of recent work upon South American ferns, the curious Colombian plant (*André* 3497) here discussed was met with in material from the herbaria of the Field Museum of Natural History, the New York Botanical Garden, and the Royal Botanic Gardens, Kew. It had been distributed as *Aspidium munitum* Kaulf. [*Polystichum munitum* (Kaulf.) Presl, a Pacific coast species of temperate North America], an identification suggested presumably by the polystichoid form of the pinnae; but it belongs to the genus *Dryopteris* and is nearly related only to a Colombian species, *D. longicaulis* (Baker) C. Chr., previously described and figured. It may be known as

Dryopteris cornuta Maxon, sp. nov.

Rhizome epigeous, slender and greatly elongate (15 cm. long in incomplete material at hand), rampant or rigidly ascending, woody, 6–8 mm. thick, deeply sulcate, light brown, lustrous beneath a dense covering of short spreading griseous hairs, obliquely paleaceous, the scales loosely imbricate, 5–6 mm. long, subulate from a subcucullate thickened lance-triangular base (here 1 mm. broad), broadly attached, bright brown, firm, rigidly griseous-puberulous on the surfaces, similarly ciliate. Fronds few, alternate, rigidly

[1] Published by permission of the Secretary of the Smithsonian Institution. Received April 10, 1929.

Fig. 1.—*Dryopteris cornuta* Maxon. Two-fifths natural size

ascending, 60–65 cm. long; stipes 10–15 cm. long, 1.5–2 mm. thick, brown, lustrous, very obliquely attached, appearing long-decurrent upon the rhizome, griseous-puberulous, bearing a few scattering scales; blades nearly linear, 50–55 cm. long, abruptly acuminate-caudate at apex, simply pinnate, 6–7 cm. broad in the basal third, slightly narrowed at the rounded or abruptly acutish base, only the basal pair of pinnae reduced (1.5–2 cm. long), occasionally subhastate; vestigial pinnae wanting; rachis similar to stipe, stoutish; pinnae very numerous (about 52 pairs below the inciso-lobate apex), those of the basal fourth opposite or subopposite, the others alternate, all distant, spreading, upwardly falcate, linear, obtuse or acutish at tip, strongly inequilateral at base, narrowly convex-cuneate below, deltoid-auriculate above, entire, sessile, provided with a prominent dark indurate mammiform aerophore; largest pinnae 3.5 cm. long, 6.5 mm. broad at middle; midribs stout, elevated above, slightly so beneath, griseous-strigillose, as also the whole upper leaf surface, the under side sparingly so; veins about 25 pairs in the largest pinnae, very oblique, for the most part closely once-forked, each branch fertile about midway to the margin, the sori thus appearing paired; vein of basal auricle with 3–6 pairs of pinnately arranged branches, these similarly fertile; sori small; indusia minute, brown, setulose, shriveling but persistent; sporangia few, glabrous. Leaf tissue firm-herbaceous, dull brown, eglandulose.

Type in the herbarium of the Royal Botanic Gardens, Kew, collected near Altaquer, Colombia, May 23, 1876, by E. André (no. 3497). This is the best of the three specimens above mentioned, and is the only one showing the rhizome.

Allied closely to *Dryopteris longicaulis* (Baker) C. Chr., the original collection of which (*Kalbreyer* 1454) is known to me from Baker's illustration[2] and from fragments of the type kindly forwarded from Kew. Kalbreyer's specimen, from Antioquia, is the only one cited by Christensen in his Monograph; but there is now at hand a second specimen, this collected at "La Gallera," Micay Valley, Department of El Cauca, Colombia, at 2,000–2,200 meters, July 1, 1922, by E. P. Killip (no. 7950), which matches the type perfectly. The species is evidently very rare.

Dryopteris longicaulis differs materially from *D. cornuta* in its several pairs of remote, greatly reduced basal pinnae, its fewer and regularly lobed major pinnae, its nearly glabrous under surface, its numerous veinlets, and its subglabrous indusia, as well as in other less obvious characters.

BOTANY.—*Shall the International Botanical Rules have the import of law?*[1] J. FRANCIS MACBRIDE, Field Museum of Natural History. (Communicated by PAUL C. STANDLEY.)

In the recent appearance of three scholarly papers dealing with the taxonomy of entirely unrelated plants, a contrast in interpretation of

[2] Hook. Icon. Pl. 17: *pl. 1658*. 1886.

[1] Received April 15, 1929.

and respect for the International Rules of Botanical Nomenclature is presented that seems worth commenting upon, especially since it emanates from four well-known botanists whose attitude toward these Rules, which they purport to follow, is of particular interest in view of the impending International Congress.

One paper considers the case of *Ophiopogon* and *Liriope*,[2] another Schmidel's publication of *Thelypteris*,[3] and the third describes a new species of *Muhlenbeckia*[4] and gives "the correct combination for an old species."

The case of *Ophiopogon* is met decisively: the name *Mondo* is shown to antedate *Ophiopogon* and to have been validly published; accordingly the author concludes, since "the generic name is not rejected by the International Rules * * * its restoration is inescapable." The fact that the plants are of increasing importance in horticulture, though the author himself is a great horticulturist, has not influenced his decision. His paper, in every sense, is an example of legal publication.

Similar in intent is the article concerning the publication of *Thelypteris*, which the authors regard as properly published "by the statements of the International Rules." Accordingly they use the name in preference to *Dryopteris* but admit that "to have to resuscitate it, with the ultimate necessity of scores or hundreds of new combinations, is undoubtedly a misfortune; but is no greater misfortune than was the exhumation of the equally disused *Dryopteris*, from the 'dust of synonyms,' with the resultant 500 new combinations of the Index Filicum alone." This seems to be specious reasoning—to show that this case is not similar to that of *Ophiopogon* it will be argued briefly—inasmuch as the 500 new combinations have already been made and therefore the continued use of *Dryopteris*, if it can be done legally, would avoid the addition of them to synonomy and the coining of 500 more names, all (at least theoretically) potential synonyms! In this instance it would seem that the authors, working under what has been aptly termed "the spirit of the International Rules," might have been content with their statement of the respective merits of the case for and against *Thelypteris* (according to their interpretation of the Rules), deferring new publication, since disagreement of authorities as to its validity is well known. Incidentally it may be remarked that its

[2] Gentes Herbarum **2**: 1–37. 1929.
[3] Rhodora **31**: 21–27. 1929.
[4] Contrib. Gray Herb. **81**: 67–86. 1928.

acceptance by Drs. Nieuwland and Slosson, who work under another code, is surprisingly cited as a determining factor in the authors' own acceptance! At any rate, the case of *Thelypteris* and *Dryopteris* is an outstanding example of a nomenclatorial problem not clearly to be settled without resort to conservation. Many names have been conserved with less reason or in less "justice."

How different is the situation in regard to *Mondo* (*Ophiopogon*). *Mondo* is shown indubitably to have been published validly, and so the author "takes it up," no doubt expecting that other workers under the International Rules will adopt it as he has, legally and in good faith, unless it can be shown that through error or misinterpretation his action actually does not conform to the rules followed. Possibly, or at least practically, it may have been his privilege to postpone publication under the legal name *Mondo* until a Congress could conserve *Ophiopogon*, but evidently, as a matter of course, he reached his own decision, based on the definite pronouncements of previous Congresses. A few botanists[5] think that it should definitely be made legal to leave such matters, at the discretion of the individual, to the action of a succeeding Congress. A special ruling on this, however, scarcely appears to be necessary, since the legality of names such as *Layia* versus *Blepharipappus* and *Thelypteris* versus *Dryopteris*, which can be settled only by special law anyway, will automatically be decided eventually, and those working in the spirit of the International Rules will naturally defer publication involving *questionable* name-changes until a Congress acts. Others will not do so in any event; but unless their case is clearly within the law it will have no permanent standing. The ruling proposed, applicable to the status of a validly published name like *Mondo*, would, therefore, only weaken the Rules and serve as an entering wedge of disapproval for individuals with some personal dislike for accepting a given name, even though taken up legally.

But the third author—to return to the consideration of the legal status of the three matters referred to at the beginning of this paper—has lapsed in his long-evident desire, as shown by his other (and meritorious) publications, to follow the International Rules. He publishes a new species under the name *Muhlenbeckia* and makes a new combination (with this name) which he even calls "correct," although cognizant of the recent restoration of an earlier and valid generic name. Can such disregard for the International Rules be justified?

[5] Candollea **2**: 515–519. 1926.

It violates Articles 15 and 50. It substitutes individual preference for law. It is even contrary to the spirit of the International Rules, for no explanation is vouchsafed of the modification to suit personal fancy. The author thus cloaks his violation with the apparent excuse of ignorance. The consequences of such independent action by individuals purporting to work under the International Rules may become serious. As one botanist recently inquires pertinently, "and supposing that the desired alterations in the Rules are eventually made, do they expect their fellow botanists to accept them, when they themselves have set the example of departing from the present Rules?" The botanical congress at which the Rules were drawn up with wisdom added finally Article 58.

The case of *Ophiopogon* and the case of *Muhlenbeckia* are exactly parallel examples involving nomenclatorial changes in accord with law. The author who considers the first also deals with the second, and necessarily rejects *Muhlenbeckia* as he rejects *Ophiopogon*. Is his work invalidated because someone has (or may have) suggested that one or both names be conserved? At what particular date from Congress to Congress do such suggestions have the force of law? Is a legal name-change illegal because it happens to be made two or three years before a Congress meets, or just what *is* the term of the blank period for the functioning of International Botanical law? Perhaps the *nomina conservanda* likewise are no longer conserved during this time, and verily one should publish warily. (The situation could become even more complex.) And finally, do the International Rules cease to operate when the plants considered are cultivated, and, if so, grown to what extent? In the case of *Muhlenbeckia* at least, any anxiety felt for one species often cultivated has been dispelled by the creation, with good reason, of a separate genus for it—so it has to be known by another name, after all. Or perhaps one should not let scientific considerations change the name of any cultivated plant—a "distressing" necessity to some, apparently, to be thwarted at all odds.

But the merit of taking up the earlier and valid names for *Ophiopogon* and *Muhlenbeckia* is, after all, of incidental interest; the important fact remains that, as these names have been restored legally, other botanists, even if they feel the restoration ill-advised, may be expected to support it. If compliance with the law, where the working of the law is perfectly clear as in these cases, cannot be taken for granted, one may well ask if the Rules are more than a scrap of paper. "What useful purpose is served by departure from the Rules,?" the botanist

quoted above has inquired. "If the intention is to bring about their amendment, would not a detailed statement of the case be equally effective?"[6]

The rather amazing theory has been advanced by some in recent years that botanical law is not to be modified or extended. Rather it it is of paramount importance that it shall not be changed by the individual as a law unto himself. And if the Rules are to be regarded with increasing respect, any alteration ought to be made only by a representative group of taxonomists chosen for the purpose and not by a heterogeneous crowd of "botanists" many of whom, as members of distantly related and highly restricted fields, naturally enough can have no proper understanding of the taxonomic problems involved, perhaps quite unaware that permanent stability in nomenclature can never result from ill-considered arbitrary action. This, perhaps, is an unreasonable hope if one is to judge from the names signed to a recently distributed protocol proposing emendation of the Rules. One may well wonder how much experience and knowledge was back of the majority voting there recorded! There are many "border-line cases" subject to different interpretations, and the responsibility for their settlement necessarily rests upon such a Congress or its committee. To mention only a few names besides *Thelypteris* and *Dryopteris*, there are *Gerardia* and *Stenandrium, Allocarya* and *Maccoya, Parosela* and *Dalea*, and perhaps, in the minds of some, *Nymphozanthus* and *Nuphar*. None of these cases is exactly similar to another. *Parosela* has technical standing and the necessary name-changes have been made, but to some its standing is not clear. *Allocarya* has no legal standing, but no transfers to *Maccoya* have been made, so the acceptance of the latter by any botanist, this being legal, would make it a case equivalent to those of *Ophiopogon* and *Muhlenbeckia*, and to conserve it arbitrarily after the transfers have been made would serve no useful purpose and be analogous to locking the door after the horse has been stolen. *Nymphozanthus*, apparently, is valid and it is highly to the credit of the author who restored it, according to law, that he had the courage of his convictions. He did not evade the law and thereby create disrespect for it. This case is an excellent example of an unfortunate name restored by the working of established law. It is very question-

[6] Certain provisions, probably transitory and mostly minor, that in the name of good taste or judgment are regularly ignored or violated, even as in civic law, will scarcely be cited by any but a narrow mind in trying to refute the correctness of my general premise.

able, however, if any subsequent Congress should interfere in this or any other case in which the law has been clearly observed, certainly rarely. Even if modern botanical law is in the process of formulation, surely we cannot at will strike out the very fundamentals of it, when a name or an action in which it results displeases us, and still have any firm foundation upon which to build. Otherwise we may well ask ourselves if it is our intent to stifle or to stimulate individual effort. We shall accomplish only the former if a few, powerful by connection and connection's tradition, can violate adopted law and have their action accepted. Simply because there are troublesome and "unfortunate" cases, often involving large genera, is disrespect for the International Rules to be encouraged by unnecessary conservation, thus condoning disobedience to the law when the law has clearly sanctioned, if not demanded, generic and specific changes? Shall, for example, *Celmisia* be conserved for *Elcismia* because known in cultivation or for any other reason, though dozens of new names have already been made in good faith legally? "The name has not been mentioned in the lists of *nomina conservanda* or *nomina rejicienda* so it (*Celmisia*) must take its course under the rules of priority," wrote this sincere and careful follower of the Rules in 1913. So, likewise, shall *Berlinia* be permitted to supplant the earlier *Westia*, the restoration having been made, or *Bassia—Madhuca; Ophiopogon—Mondo;* or *Muhlenbeckia—Calacinum?* (Many examples could be found that would be associated with most of the active taxonomists of the world).

Of course, the answer most emphatically for every seeker of stability in nomenclature and for every sincere supporter of the International Rules is "No!" Let the coming Congress, then, concern itself rather with the many moot questions that truly require congressional consideration, and take extra-legal action in settling them only after most cautious and careful analysis of all contributing factors, so that respect for already established law may not be further endangered.

PALEOBOTANY.—*A palm nut of* Attalea *from the upper Eocene of Florida.*[1] EDWARD W. BERRY, Johns Hopkins University.

The specimen to be described comes from the Ocala limestone, which is a soft, white to yellowish, porous limestone underlying considerable areas in western and peninsular Florida. It was long thought to be of

[1] Received April 13, 1929.

Oligocene age but Cooke[2] showed in 1915 that it was beneath the Vicksburg in western Florida, and that it was represented beneath the Vicksburg in Alabama and Mississippi by the upper part of the Jackson of those two states. The history of the term Ocala and its interpretation is given in some detail in the paper cited.

The Ocala is a typical shallow, clear-water, marine deposit, carrying a large fauna which includes *Basilosaurus* (*Zeuglodon*) and numerous orbitoid foraminifera. So far as I know no fossil plants have been recorded in the Ocala, as might be expected from its character, although it doubtless contains some drift wood to which no one has paid any attention. Recently Mr. Herman Gunter, State Geologist of Florida, sent me the calcified palm nut which forms the subject of the the present note. This nut was picked up on the eroded surface of the Ocala limestone, and both its identity and the character of its preservation indicates that it undoubtedly was weathered from that formation. The exact locality is 2½ miles northeast of Williston, Levy County, on the property of the Florida Shell Rock Company.

The specimen proves to be a new species of an existing tropical American genus of palms, hitherto unknown as a fossil, and of considerable interest for a variety of reasons. Since only the type specimen is known this has not been sacrificed in an endeavor to ascertain what, if any, of the internal structure has been preserved. It may be incompletely described from its external features as follows:

Attalea gunteri Berry, n. sp.

Figs. 1, 2

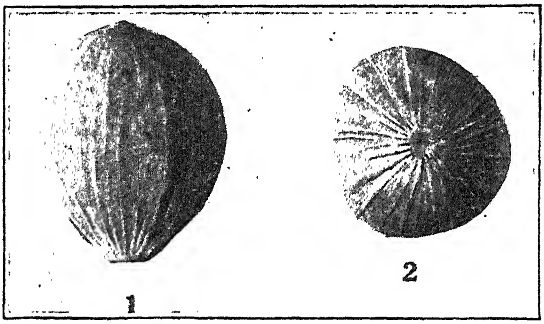
Nut sub-sperhical or slightly turbinate, broadly rounded above with a faint apical pole, narrowing slightly below the middle to the truncated base. Sub-symmetrical in form. Nearly circular in transverse profile and evidently borne with others in a loose cluster in life. Peduncle scar large and central. Substance consisting of longitudinal fibres, of which some are larger and more higly sclerotized than the ground mass. Length 3.2 centimeters. Diameter about 2.5 centimeters.

It would, of course, be highly desirable to confirm the external resemblance of the fossil to the modern fruits of *Attalea* by some information as to the number of contained seeds, but this is impossible without sacrificing the specimen. The only genus which I regard as possibly liable to confusion with *Attalea* is the genus *Elaeis* of Jacquin, a small genus ranging in the modern flora from Costa Rica to the Amazon

[2] C. W. COOKE. *The age of the Ocala limestone.* U. S. Geol. Survey Prof. Paper 95: 107–117. 1915.

and equatorial west Africa. In *Elaeis* the largest fruits are considerably smaller than the fossil.

The existing species of *Attalea* number between 25 and 30, and range from Central America and the Antilles to the Amazon Basin, and along the eastern Andes to Bolivia. Its fruits are readily transported for short distances by ocean currents, although it is not especially a coastal type, and it might readily have been introduced into southeastern North America during the upper Eocene by that means. That the genus was actually a member of the upper Eocene flora of Florida, and that the fossil does not represent a stray drift-fruit from elsewhere which was stranded on the Florida coast I regard as highly probable.



Figs. 1, 2.—Side and proximal views of *Attalea gunteri* Berry, n. sp., natural size, from the Ocala limestone of Florida.

This is indicated by the perfect condition of the fossil, which shows no signs of abrasion, maceration, incrustation or attacks of marine organisms, and also by the fact that the upper Eocene floras of southeastern North America[3] are the most tropical that are known from this area.

One feature of interest in connection with the finding of a fruit of *Attalea* in the marine Ocala is the abundance of palm remains in the more littoral deposits of Jackson age in Georgia, Tennessee, Kentucky, Louisiana and Texas. The genera *Phoenicites, Thrinax, Sabalites, Nipadites, Palmocarpon,* and *Palmoxylon* have been recognized in beds of this age in the states mentioned. The last mentioned genus, *Palmoxylon,* is a form genus based on petrified palm wood. Two species of *Palmoxylon* have been described from the Jackson and more are probably represented, silicified palm wood being so abundant in

[3] See the account of the Jackson flora in Edward W. Berry, U. S. Geol. Survey Prof. Paper 92. 1924.

the upper Jackson of Louisiana that the Indians used it as a source of material for their stone implements.[4]

Although no fossil species of *Attalea* have hitherto been recorded, the genus was in existence at this time, as is attested by quantities of fruits of a species of *Attalea* which I have from the late middle Eocene of northwestern Peru. The native genera of palms in the modern flora of Florida are *Thrinax*, *Coccothrinax*, *Sabal*, *Serenoa*, *Roystonea*, and *Pseudophoenix*, all of which have small drupaceous or berry-like fruits, entirely unlike the fossil form.

The present species should be readily recognized if encountered by future collectors, a contingency much to be hoped for, since it will enable sections to be cut, and thus verify or disprove the present identification based upon the external features.

ZOOLOGY.—*The ambulatory tubes and other features of the nema* Draconema cephalatum.[1] N. A. COBB, U. S. Department of Agriculture.

There is no adequate published description of the locomotion of *Draconema* and its numerous marine relatives; very few persons have ever witnessed one of these nemas perambulating its natural substratum.

Draconema moves much after the manner of the ordinary inchworm, or measuring worm. The caterpillar called the "inchworm" has two bunches of feet, a bunch near each extremity. Standing on the bunch of hind feet, it stretches forward and takes hold with the front bunch. Then, releasing the hind bunch, it draws the body forward into a loop so that the posterior bunch may attach itself near the front one. Loosening the front bunch, the caterpillar again stretches forward, etc.

It is convenient to speak of the two attachment organs of the adult *Draconema* as "soles." The method of attachment of these soles to the substratum in *Draconema* is very different from that of the inchworm. The sole of *Draconema* is armed with projecting hollow setae connected with internal glands supplying a sticky and, presumably, non-water-soluble secretion, and it is by the aid of this secretion emerging from ends of the hollow setae that the sole is attached.

[4] EDWARD W. BERRY. Pan-Amer. Geol., **45**: 273–276. 1926.

[1] Received May 2, 1929.

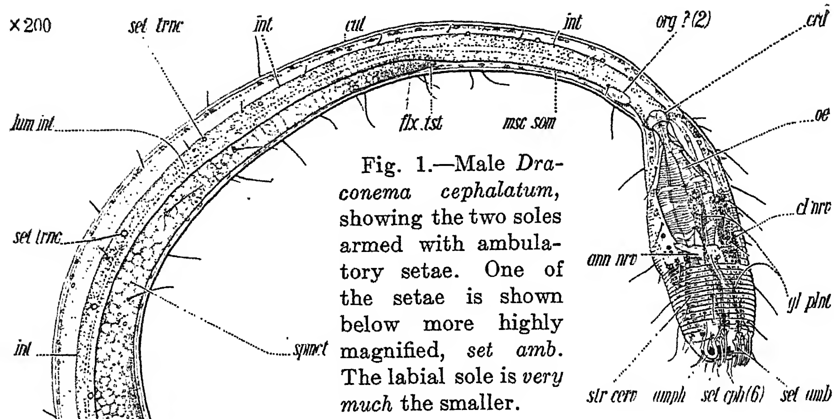
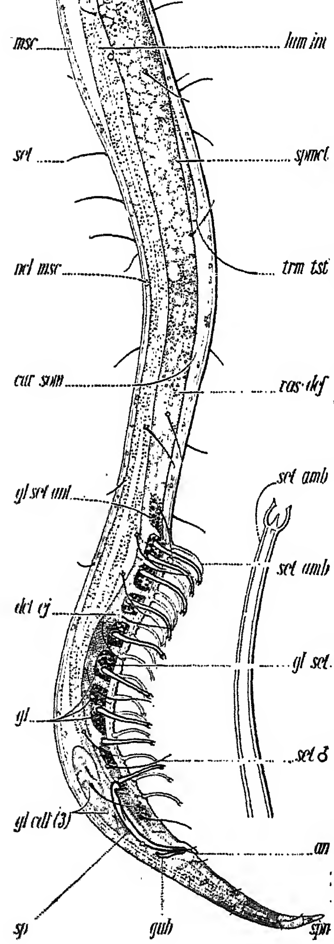


Fig. 1.—Male *Draconema cephalatum*, showing the two soles armed with ambulatory setae. One of the setae is shown below more highly magnified, *set amb*. The labial sole is *very much* the smaller.



A glance at Fig. 1 will enable the reader at once to understand the posterior "sole" of *Draconema cephalatum*. It is of considerable extent, occupying most of the posterior fifth of the ventral surface of the body, and is characterized by very obvious, longitudinal groups of curved ventrad setae.

The much smaller anterior sole is very near the front of the head on the dorsal side, and is characterized by setae, smaller than, but similar to, those of the other sole.

The main sole.—Favorably stained specimens exhibit the structure of the ambulatory adhesion tubes, as well as of the associated multicellular ventral glands arranged in a long ventral group opposite to and a little in front of the major sole. Each adhesion tube connects, at its base, with a duct that leads to a separate gland. The anterior pair may be taken as typical of any group-member of this compact composite series of glands (see Figs. 1 and 2). This anterior pair is sometimes more distinctly separated from the general mass of the glands than are any of the subsequent

pairs or groups; and each of these two glands proves to have three nuclei. (See Fig. 2.) The cells of each gland, as well as their spheroidal nuclei, increase in size from front to back, the anterior, i.e., distal, cell having less than one-eighth the volume of the posterior; the nucleus in the small anterior cell is also less conspicuous. This group (pair) of glands is more or less clavate in form and is nearly as long as the corresponding body diameter. Posteriorly, each gland diminishes suddenly in diameter to form a duct about half as wide as one of the adjacent annules of the cuticle. Near the gland the wall of the duct contains somewhat elongated nuclei of considerably smaller size than the nuclei of the glands. The duct also lacks the granular character of the glandular cells themselves. The two ducts, at first ventral, diverge backward to the two foremost adhesion tubes, and are one to two times as long as the glands. Near where a duct enters the somewhat swollen base of an adhesion tube, there is a small duplex enlargement or ampulla. In the specimens under examination, only in the very basal portion of the adhesion tube is there any indication of the staining action of the acid carmine.

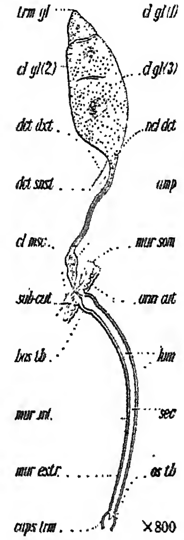


Fig. 2.—Anterior ambulatory seta of *D. cephalatum* with its 3-celled gland, its 3-celled mate concealed, though part of its duct shows,—*dct snst.*; *som*, body wall; *cl msc*, somatic muscle; *an cut*, cuticular annules; *mur ext* and *mur int*, outer and inner walls of ambulatory tube; *os tb*, secretory pore.

The numerous glands composing this ventral series are so closely packed together that, as a rule, it is difficult to distinguish the exact number of groups, but it is evident that throughout the series the glands are arranged in groups side by side, apparently mostly in pairs or quartets, the number of glands being commensurate with the number of adhesion tubes. On occasions when the entire group of glands is slightly separated from the body wall, and therefore from the bases of the adhesion tubes, the ducts leading to the tubes are distinctly visible, and have the appearance, when viewed laterally, of a rather complicated plexus.

The minor, or cephalic, sole.—The dozen or so adhesion tubes and glands of the cephalic sole have the same general plan as the sublateral and subventral ones of the posterior sole just described. The glands connected with the cephalic tubes (*gl. plnt*) are located mainly dorsad in the anterior two-fifths of the neck between the oesophagus and the body-wall; there are two dorsally

sublateral groups of glandular cells and four subdorsal groups, corresponding to a similar grouping of the six pairs of adhesion tubes. The glands of the cephalic sole are sometimes rather more strongly stained than those of the posterior sole in the same specimen, but present the same general anatomical and histological structure. Referring to the dorsally sublateral cervical glands as examples (see Fig. 1), these are distinctly granular in structure and apparently duplex, that is, have a well marked constriction near the middle, on opposite sides of which, fore and aft, is a considerable volume of nuclear (?) matter; the remaining portion of the cells is rather coarsely granular, the granules measuring nearly 1μ in diameter. This duplex glandular mass is half as long as the neck and anteriorly tapers to a tubular portion not much wider than one of the cervical annules. This narrow portion of the gland in turn tapers to a very narrow duct about 2μ in diameter, which swells to form a fusiform duplex ampulla as wide as one of the coarser cervical annules. The ampulla empties forward through a short narrow duct, 1 to 2 μ wide, directly into the base of the corresponding adhesion tube, where a little stained matter may usually be seen. The adhesion tubes reach exactly to the lips, so that their outpour is practically terminal. All these details are shown on a small scale in Fig. 1.

The distal extremity of the ambulatory tube is somewhat bell-shaped, and the lumen of the tube is prolonged into the cavity of the bell through a short conoid extension. The significance of this bell-shaped structure remains more or less problematical. No elements have been seen in the tube, or in the bell, that could be regarded as contractile, and one therefore seems obliged to assume that whatever changes of form are exhibited by this bell-shaped structure are due to such factors as its own elasticity, the pressure of the internal secretion and counter pressure of the external water. It would seem advantageous to the nema if the secretion which flows out through the bell-shaped organ could be "cut off" at will, and it is conceivable that this bell-shaped affair in some way accomplishes that end. Again, it is conceivable that the bell may mechanically give to the end of the tube a greater adhesiveness, conceivably through suction,—a suction that might be made to vary with the relationship of the distal end of the tube to the substratum, as in the familiar elastic concave rubber suction disc.

The facts that the setae of the inner rows are always the shorter, and that all the setae are incurved, suggest that a suitable substratum may be a microscopic filament, or a thin edge of something. This

thought arises from the fact that the main sole appears "bow-legged," as it were. Such apparently suitable thin and narrow forms of substratum occur on certain marine algae and, as a matter of fact, at least two observers—Cobb and Chambers—have seen *Draconema* perambulating the surface of algae.

In balsam specimens from Hudson Bay the body-wall tissues surrounding the mouth-opening have a golden yellow color and take on the form of a six-parted, but twelve-pointed, star.

Probably the excretory pore is at the lips. I formerly referred to a cell just behind the cardia as possibly representing the renette; this suggestion may not be well founded. In this region I observe two of these cells lying side by side in subventral position (see Fig. 1), separated by a small space. In the same latitude, just behind the minute cardiac cavity, on each side of the intestine, there is a rather compact group of granular cells containing about a dozen nuclei. These groups are as long as the corresponding body diameter, and about half as wide as long. Between the two groups, on the dorsal side, there is a pair of subdorsal granular cells rather closely resembling the subventral ones just described. As to the function of these lateral groups of cells, it seems not impossible,—as they are free at their posterior ends and seem connected with the intestine anteriorly,—that they may be special glands associated with digestion. There is a similar pair of lateral groups of cells in front of the cardia, emptying (?) backward. I do not think the possibility is excluded that some of these cells are nerve cells.

The intestine is composed of cells of such a size that about six are required to complete a circumference. The thin refractive lining is hardly 1 μ thick. The cardia, as usual, presents a distinct group of closely packed nuclei, indicating that it is composed of cells of rather small size, of which the number is probably about fifteen to twenty. Notable is the presence of *scattered cells in the wall of the intestine which stain differently* from their neighbors. These, no doubt, discharge some special function. Thus far they have been observed only in the anterior portion of the intestine.

The portion of the neck opposite, and adjacent to, the oesophageal constriction, except such portion as is occupied by the glands of the minor sole, is rather closely packed with nerve cells.

The lateral fields are one-third as wide as the body and contain a considerable number of nuclei rather irregularly arranged.

The cuticle in the posterior region of the tail is traversed by radial elements that give rise to a finely punctate appearance on the surface (see Fig. 1).

An interesting observation is the apparent connection of the tandem group of three caudal glands with the dorsal field by means of a narrow strand running forward, possibly of a nervous character, as is suggested: 1, by its form and position; 2, by its size and structure.

The internal extremity of the gubernaculum lies near the body axis and is connected fore and aft with the ventral body-wall by slender strands of muscular tissue. The testis is now believed to be reflexed, not outstretched as formerly figured.

The broad, rapidly tapering ovaries,—the anterior lying to the right, the posterior to the left,—are reflexed to nearly opposite the vulva and contain comparatively few ova, arranged in single file in the wider part, elsewhere irregularly. Hundreds of subspherical sperm cells may occur in the uterus. Usually there is one egg at a time in the uterus, thin shelled and smooth, and deposited before segmentation begins. The eggs are three-fourths as wide as long and about two-thirds as long as the corresponding body diameter.

Some of the results of the present investigation have been more or less definitely forecast by various observers on several occasions, notably by Steiner and Irwin-Smith, both of whom from inadequate material, have, with admirable insight, suggested the probable connection of the adhesion tubes with internal structures and also the possibility of the glandular nature of these latter.

While no doubt now remains that both the major and minor soles are glandular and are organs of locomotion, it still seems to me quite doubtful whether we fully understand the bodily structure of *Draconema*. The form of the head and neck and other parts do not seem to be explained merely on the basis of the use of these two "sticky" soles in locomotion. There probably are other unknown factors playing a part in the activities of *Draconema* that will further explain its highly peculiar and interesting structure.[2]

[2] *Nomenclature.* The proposal of the genus *Draconema* in 1913 appears reasonable in view of the fact that at that time the published descriptions of the species belonging to its family, though in no case as complete as desirable, indicated the existence of two (or more) genera, the type species of one of which should be that originally named by Claparède *Chaetosoma ophiocephalum* 1863 (not *Chaetosoma* Westwood, 1851, Coleoptera). *Draconema cephalatum,* was then, and continues to be, thought generically different from Claparède's *ophiocephalum.* The name *Chaetosoma,* being preëmpted, should be replaced by its synonym *Notochaetosoma* Irwin-Smith 1917. Should the opinion prevail that all the described forms of the family belong to one genus, then the oldest synonym for *Chaetosoma* would be *Draconema,* and should be substituted. In that event, the family name would naturally become *Draconematidae;* in any case, it seems likely that *Draconema* is a better representative of the group than the only other genus so far proposed, *Notochaetosoma.*

Draconema cephalatum is cosmopolitan, and seems to have been described by several different authors under as many different specific names, e.g., *annulatum* Ditlev., *haswelli* Irwin-Smith, *hibernicum* Southern.

SCIENTIFIC NOTES AND NEWS

Dr. WILLIAM BOWIE, Chief of the Division of Geodesy of the U. S. Coast and Geodetic Survey, and Comdr. N. H. HECK, Chief of the Division of Terrestrial Magnetism and Seismology of the same bureau, have been elected alumni members of the Sigma Xi Chapter at Lehigh University.

Dr. F. S. BRACKETT has joined the Smithsonian Institution to undertake studies in the correlation between wavelengths and intensities of radiation and the growth of plants, and also fundamental investigations of the chemical relations of radiation such as may throw light upon the problem of so-called photosynthesis. Dr. O. R. WULF, of the Fixed Nitrogen Research Laboratory, is also associated with the Institution in the study of methods of measurement of ultra-violet rays useful for the prevention and cure of rickets in human beings and animals.

Dr. C. U. CLARK, formerly assistant professor at Yale University, will undertake for the Smithsonian Institution, beginning in September, research in the archives of Spain with reference to documents and artifacts relating to the aborigines of the Americas and more particularly the Mayas and Toltecs of Central America.

The U. S. National Museum has received the large and valuable collection of Lepidoptera of the Brooklyn Museum as a permanent deposit. This deposit has been made because of a change of policy on the part of the Brooklyn Museum, which will devote its facilities entirely to exhibit collections. There are included in the collection some 66,000 specimens, of which 650 are types.

Dr. J. M. ALDRICH, Associate Curator of the Division of Insects of the National Museum is in Europe for the purpose of examining muscoid types at several museums and of making collections in northern Norway and Sweden, particularly of Diptera, for comparison with similar forms occurring in the northern part of North America.

Mr. CARL HEINRICH, of the Bureau of Entomology, is in Guatemala investigating a reported occurrence of the corn-borer.

The National Museum has recently acquired, through the Roebling Fund, a large cone-shaped iron meteorite weighing 1060 pounds from the Zuni Mountains, 40 miles south of Grants, New Mexico.

Dr. J. W. GIDLEY, of the Division of Vertebrate Paleontology of the National Museum, has recently returned from Melbourne, Florida, where he continued excavations in connection with his study of the Pleistocene fauna and evidence of early man. Mr. C. W. GILMORE, Curator of the same Division of the Museum, is in charge of a party collecting Upper Cretaceous vertebrates in the San Juan Basin, northwest New Mexico.

Dr. R. ENDO, of the Educational College, South Manchuria Railroad, Moukden, has recently arrived at the National Museum with collections of Lower Paleozoic fossils that he plans to study during the next two years.

Dr. F. H. H. Roberts, of the Bureau of American Ethnology, will make during the summer a reconnaissance in the Zuni area of New Mexico and will excavate a series of early Pueblo ruins 60 miles west of the modern pueblo of Zuni. Dr. J. N. B. Hewitt, of the same Bureau, is in Canada for the purpose of completing his ethnologic and linguistic studies relating to the League of the Iroquois and to complete translations of certain Chippewa texts.

Dr. Luciano J. Moraes of the Geological Survey of Brazil, has spent some weeks in Washington in a study of the organization of geologic work in the federal bureaus, museums, and other institutions.

Dr. George P. Merrill, Head Curator of Geology at the U. S. National Museum, was the honor guest at a dinner given by his friends and associates on the occasion of his seventy-fifth birthday, May 31, 1929. C. G. Abbot, Secretary of the Smithsonian Institution presided and brief addresses were made by Drs. Marcus A. Benjamin, L. O. Howard, H. S. Washington, and H. W. Wiley. Miss Margaret Moodey presented to Dr. Merrill a volume containing letters of congratulation from some 160 friends. Dr. Merrill has been connected with the National Museum since 1881.

Frank Reeves, of the U. S. Geological Survey, is on leave for the period May 15 to December 15, 1929, to engage in private work for an oil company in Canada.

Obituary

Carey V. Hodgson, geodesist of the Coast and Geodetic Survey and a member of the Academy, was drowned May 20, 1929, during a storm on Chesapeake Bay. He was born at Wilmington, Ohio, July 11, 1880, attended Wilmington College and Haverford College, Ohio, and shortly after his graduation in 1904 joined the Coast and Geodetic Survey. He became assistant chief of the division of Geodesy in 1920 and served in that capacity since. During the war he was a major in the Corps of Engineers and saw service overseas. His chief interest was in geodetic astronomy and surveying.

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GEOLOGY.—*The Chesapeake Miocene basin of sedimentation as expressed in the new geologic map of Virginia.*[1] W. C. Mansfield, U. S. Geological Survey. (Communicated by L. W. Stephenson.)

Introduction

The revision of the Chesapeake group of the Coastal Plain of Virginia shown on the new geologic map of Virginia is the result of field and office work carried on at different times since the year 1918. The inner margin of the group as shown is taken in part from previous maps, but some additional work on this boundary in Virginia was done by R. P. Meacham, of the Virginia Geological Survey, and by me.

In Maryland the Miocene stratigraphy has been admirably worked out. The results were published in 1904 as the Miocene volume of the Maryland Geological Survey, and form a working basis for interpreting the stratigraphic sequence of the deposits to the south.

The abundant molluscan faunas preserved in most of the deposits afford reliable data for determining the horizons and the age relationships. Each bed carrying a distinctive fauna has been traced inland as far as possible up the major valleys.

On the map, Figure 2, which is later discussed, I have extended my observations, for completeness, into North Carolina, although I have not so thoroughly studied the faunas there as in Virginia.

Chesapeake Group

divisions and thickness

The Chesapeake group of Virginia is divisible into four formations, which in ascending order are: Calvert, Choptank, St. Marys, and Yorktown. The Yorktown has not been recognized in Maryland.

[1] Published by permission of the Director of the U. S. Geological Survey. Read before the Geological Society of America December 26, 1928. Received April 22, 1929.

The thickness of the Chesapeake group of Virginia, as observed from the exposures, is estimated to be 575 feet. This estimate corresponds closely to that part (about 550 ft.) assigned by Darton[2] to the Chesapeake group in a well boring at Fort Monroe in southeastern Virginia. The total thickness of the Chesapeake group, as reported by Woolman[3] in the wells at Crisfield, on the eastern shore of Maryland, is 719 feet. These wells are southeast of the outcrops of the Chesapeake group

TABLE 1.—Table Showing Climatic Conditions Indicated by the Molluscan Faunas of the Chesapeake Group

Formations		*Suggested climatic conditions*	*Latitude of most closely related off-shore Recent fauna*
Yorktown	Upper part (fragmentary beds and beds at Suffolk)	Approaching warm temperature	A little farther south
	Lower part (below fragmental series and lower bed at Grove Wharf)	Cool temperate	About the same or farthert north
St. Marys	(Later beds in Virginia)	Moderately cool temperate	About the same, suggesting farther south
	(Upper beds in Maryland)	Approaching warm temperate	Farther south
Choptank		Cool temperate	About the same or perhaps a little farther south
Calvert		Approaching warm temperate	Farther south

along the Chesapeake Bay, in Maryland, and the greater thickness indicates that the beds thicken down the dip.

Sanford[4] states that well records indicate that the bottom of the Chesapeake group lies 600 feet below tide-water at Fleet Point, Northumberland County, Va. These wells are nearly north of Fort Monroe, where the thickness of the Chesapeake group was reported to be about 550 feet. This would indicate that the thickness of that part of the Chesapeake group below the Yorktown formation is greater in the northern part of the State than in the southern part.

[2] N. H. Darton. U. S. Geol. Surv. Geol. Atlas, Norfolk folio, no. 80, p. 3. 1902.
[3] Lewis Woolman. New Jersey Geol. Surv. Ann. Rept. 1894: 184. 1895.
[4] Samuel Sanford. Va. Geol. Surv. Bull. 5: 249. 1913.

DISTRIBUTION

The inner or western limits of the Miocene formations in Maryland, Virginia, and the Carolinas are shown on the accompanying map (Fig. 2), the data for Maryland being taken from the Maryland Geological Survey's Miocene volume, 1904.

The line marking the inner limit of the Calvert, the basal formation, crosses Maryland and extends into Virginia nearly to, if not to, Petersburg; on the Appomattox River; that of the Choptank formation crosses Maryland but extends only about as far as Rappahannock River in Virginia; that of the St. Marys formation nearly parallels the Choptank boundary in Maryland and extends to the Nottoway River in southern Virginia and perhaps farther south; and that of the Yorktown begins near the Rappahannock River, Va., and extends much farther south in Virginia and North Carolina than the other formations.

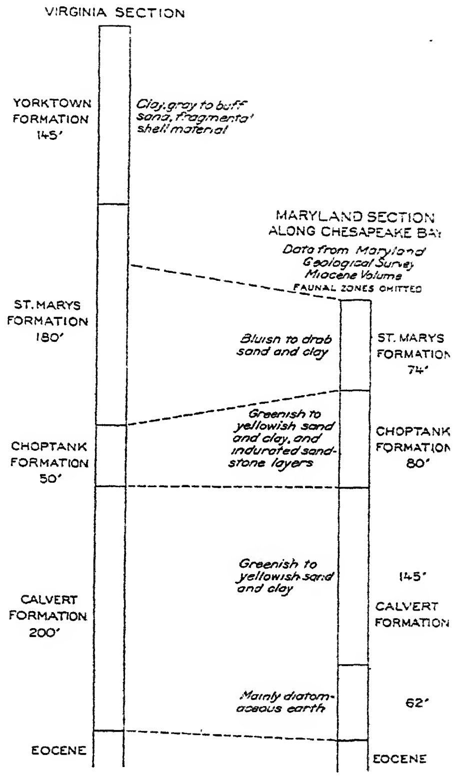


Figure 1.—Columnar sections of the Miocene of Maryland and Virginia.

The distribution of the formations of the group in Virginia shows that the St. Marys formation overlaps the Choptank and Calvert formations to the south and that the Yorktown formation transgresses westward over all other formations of the Coastal Plain and laps over a few miles on the crystalline rocks which underlie the eastern portion of the Piedmont Plateau.

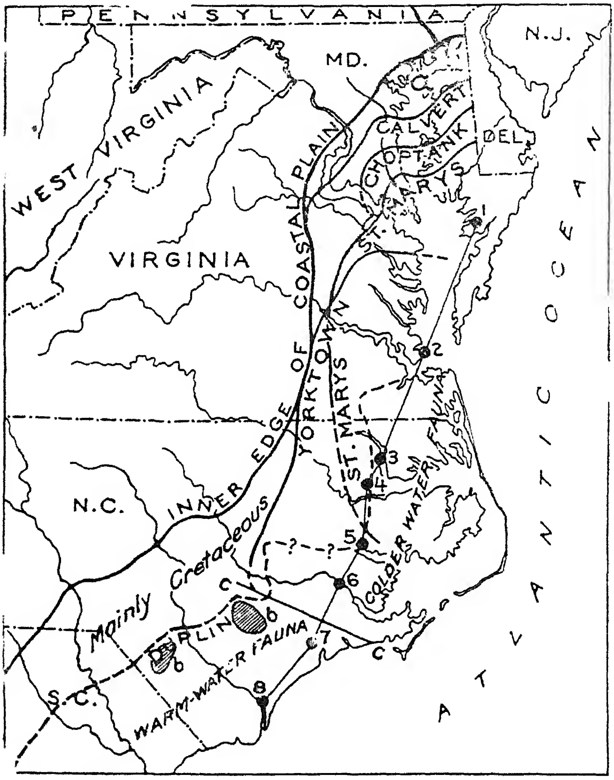


Figure 2.—Inner limits of the formations of the Chesapeake group and Duplin marl. a = area occupied by Eocene and Cretaceous deposits in Virginia and Maryland. b = westernmost patches of Duplin marl in North Carolina. $c - c$ = line separating late Miocene beds with "colder-water fauna" from those with "warmer-water fauna." Numbered line indicates location of section shown in Figure 3.

The credit for the first recognition of the great western transgression of the Yorktown sea, as now interpreted by me, belongs to Dr. A. A. Olsson,[5] whose "Murfreesboro stage," recognized on the Meherrin River at and near Murfreesboro, N. C., and at Petersburg and along James River, Va., and elsewhere, belongs in reality to the lower part

[5] A. A. Olsson. Bull. Am. Paleont. Soc. 5: 155–163. 1917.

of the Yorktown formation. The name "Murfreesboro" is preoccupied for a Paleozoic formation in Tennessee.

SECTION FROM CRISFIELD, MD., TO WILMINGTON, N. C.

A section (Fig. 3) drawn from Crisfield, Md., to Wilmington, N. C. (see trace of section on map, Fig. 2) somewhat hypothetical but checked by well records and geologic reports, shows that the down-warping which initiated the deposition of the Chesapeake group began at the north and progressed southward to the Carolinas. The absence of the Yorktown formation in Maryland indicates that there was sufficient uplift there following the deposition of the St. Marys formation to prevent further sedimentation while deposition continued in Virginia and North Carolina. The section becomes thinner toward the south by the pinching out of formations older than the Yorktown.

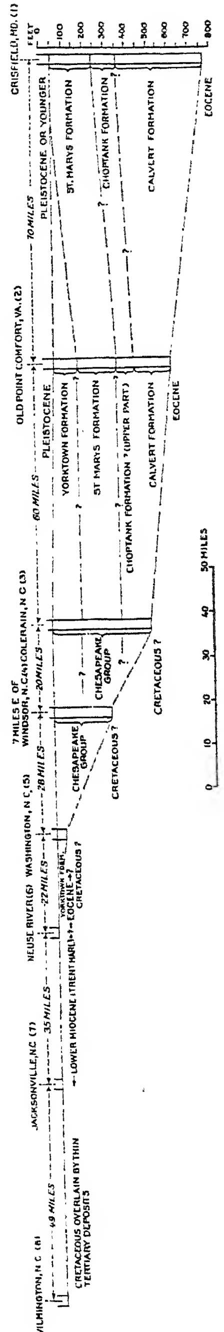


Figure 3.—Section from Crisfield, Md., to Wilmington, N. C., showing the thinning out of the Chesapeake group southward.

CLIMATIC CONDITIONS INDICATED BY THE FAUNAS

The molluscan faunas of the different zones of the Chesapeake group afford indications of temperature conditions in the sea and, by inference, of adjacent atmospheric and climatic conditions. The table shows the successive temperature conditions in the Chesapeake Miocene basin during each epoch, as at present interpreted.

DUPLIN MARL

The Duplin marl, a richly fossiliferous formation which occurs in small patches in southern North Carolina and elsewhere farther south, appears to be of nearly the same age as the upper part of the Yorktown formation as developed around Suffolk, Va. This opinion of simultaneously existing faunas was also suggested by Dall.[6]

[6] W. H. DALL. *The relations of the Miocene of Maryland to that of other regions and to the Recent fauna.* Md. Geol. Surv., Miocene, p. cxliv. 1904

The dashed line on Figure 2 indicates the western limit of the Duplin marl at the south and of beds of the upper Yorktown of approximately the same age as the Duplin at the north. On the same figure (Fig. 2), two of the most westerly patches of the Duplin marl are indicated by letter *b* and the approximate separation of the late Miocene beds carrying a "colder water fauna" at the north and a "warmer water fauna" at the south by the line *c-c*.

CONCLUSIONS

The distribution of the formations in Virginia seems to show that the St. Marys formation at the south overlaps the Choptank and Calvert formations, and that the Yorktown formation transgresses westward over all older formations of the Coastal Plain and laps over a few miles on the crystalline rocks which underlie the eastern border of the Piedmond Plateau.

The somewhat hypothetical section drawn from Crisfield, Md., to Wilmington, N. C., indicates that the down-warping which initiated the deposition of the Chesapeake group began at the north and progressed southward to the Carolinas. As the section becomes thinner at the south by the pinching out of formations older than the Yorktown, it indicates that the more northern area constituted a basin for the deposition of the sediments of the Chesapeake group, and that during the early and middle Miocene time and during the upper Miocene time prior to the deposition of the beds of the Yorktown formation as developed around Suffolk, Va., the area now occupied by the Duplin marl in the Cape Fear region practically as far out as the coast was a land area undergoing erosion.

The new map of the Chesapeake group of Virginia, as compared with the former map of the State based on the work of Clark and Miller on the Coastal Plain province of Virginia, published as Bulletin 4, Virginia Geological Survey, 1912, shows, in general: Less areal distribution of the Calvert formation; the presence of the Choptank formation; less extensive areal distribution of the St. Marys formation south of James River; more extensive areal distribution of Yorktown formation.

BOTANY.—*New Asteraceae from the United States, Mexico, and Honduras.*[1] S. F. BLAKE, Bureau of Plant Industry.

This paper contains descriptions of eight new species and several varieties as well as reallocations of several species already described.

SOLIDAGO WRIGHTII A. Gray, Proc. Amer. Acad. **16**: 80. 1880.
Solidago bigelovii A. Gray, (Proc. Amer. Acad. **16**: 80. 1880, nomen nudum;) Proc. Amer. Acad. **17**: 190. 1882.

Solidago bigelovii var. *wrightii* A. Gray, Proc. Amer. Acad. 17: 190. 1882.

The name *Solidago bigelovii*, in use for many years for a southwestern goldenrod, must give place to *S. wrightii*. Both names first appeared in 1880, *S. bigelovii* having precedence on the page but not being provided with description, while *S. wrightii* was fully described. The treatment of *S. bigelovii* at this place is as follows: "S. BIGELOVII is a New Mexican species founded on *S. petiolaris*, var., Gray in Bot. Mex. Bound. 79, collected by Bigelow, Wright, and Parry, and placed next to *S. Lindheimeriana* of Scheele, which was in Pl. Lindh. referred to *S. speciosa*, var. *rigidiuscula*." On p. 79 of the Botany of the Mexican Boundary there is no word of description; hence the species dates from its first publication with description in 1882.

Solidago wrightii was properly published in 1880, with description and reference to two synonyms,[2] as well as citation of range and collectors ("W. Texas to Arizona, Wright, Bigelow, Rothrock"). From the name given and the first cited reference and collector it is evident that *Wright* 281, the plant on which the mention in "Plantae Wrightianae" was based, is properly to be taken as type of the species. The specimen of this number in the U. S. National Herbarium (collected on "mountains between the Limpia and the Rio Grande," Texas) is rather slender, about 35 cm. high, simple below the inflorescence, with elliptic middle leaves about 3.5 cm. long and 1 cm. wide, and heads in small cymes of 2 to 4 at tips of the erectish branches, the whole forming a 12-headed cymose panicle about 7 cm. wide. *Solidago "bigelovii"* is variable in inflorescence, the heads being sometimes very few and clustered, sometimes numerous and thyrsoid on the stem and branches, but the differences appear to be purely individual and of no taxonomic or geographic significance, and I find no grounds for distinguishing *S. wrightii* from *S. bigelovii*, either varietally, as by Gray, or specifically, as by Wooton and Standley in their "Flora of New Mexico."

The only specimen examined from Texas is *Wright* 281, the type. *Solidago bigelovii* was included by the writer in Tidestrom's "Flora of Utah and Nevada,"[3] on the basis of a specimen in the U. S. National Herbarium originally labelled "Solidago remoralis, Ait. var. Nevada. Wheeler Exp. 1872." As all the Arizona specimens examined are from the southeastern part of the State, it seems probable that the species does not range so far north, and that this specimen is mislabeled as to locality.

A remarkable form with many or most of the hairs gland-tipped occurs in Arizona and New Mexico; although very distinct in its extreme, too closely connected by intermediate specimens to rank as more than a variety.

Solidago wrightii var. **adenophora** Blake, var. nov.

(?) *Solidago subviscosa* Greene, Pittonia **3**: 348. 1898.

Habit, foliage, and inflorescence as in the typical form, and similarly variable; involucre, sometimes also the pedicels, leaves, and stem, glandular-puberulous.

ARIZONA: Between Bar-foot fire station and Paradise, Chiricahua National Forest, Cochise County, alt. 2200–2400 m., 22–23 Sept. 1914, *Eggleston* 10833, 10867 in part. Rincon Mountains, 1891, *Neally* 205. Mt. Graham, alt. 2745 m., Sept. 1874, *Rothrock* 730. Mt. Lemmon, alt. 2285 m., 4 Sept. 1926, *G. J. Harrison* 3016 (type no. 1,285,413, U. S. Nat. Herb.) NEW

[2] *S. petiolaris* var., A. Gray, Pl. Wright. **1**: 94. 1852; *S. californica* var., Rothrock in Wheeler, Rep. U. S. Surv. 100th Merid. **6**: 145. 1878.

[3] Contr. U. S. Nat. Herb. **25**: 539. 1925.

Mexico: Near Gray, Lincoln County, alt. 1830 m., July 1898, *Skehan* 70. In pine belt, El Capitan Mountains, alt. 2135 m., 28 July 1900, *Earle* 489. Copper Canyon, Magdalena Mountains, alt. 2805 m., 3 Sept. 1909, *Goldman* 1673. Tularosa Creek, Sacramento Mountains, Otero County, 18 Aug. 1899, *Wooton*. Pecos River, alt. 2135 m., 23 Aug. 1903, *Bailey* 550.

When practically all the hairs are gland-tipped, as they are in the type, the difference between this plant and typical *S. wrightii* with its grayish puberulence of spreading (rarely incurved) hairs seems too great to be merely varietal. In most of the specimens cited, however, the glandularity is confined to the involucre, and it is evident that no specific line can be drawn. In the genus as a whole the presence of glandular hairs is of rare occurrence. The description of *Solidago subviscosa* Greene is strongly suggestive of this plant, but in the absence of the type specimen (Chiricahua Mountains, 15 Sept. 1896, *Toumey*) its identity is uncertain. It was said by Greene to combine some of the characteristics of *S. bigelovii* and *S. parryi*, and the description applies about as well as some specimens of *S. parryi*.

Acamptopappus sphaerocephalus var. **hirtellus** Blake, var. nov.

Stems and leaves more or less densely hirtellous; leaves often relatively shorter and wider than in the typical form.

California: Near Lone Pine, Inyo Co., alt. 1150 m., 7 June 1891, *F. V. Coville & F. Funston* 890 (type no. 1,203,074, U. S. Nat. Herb.); Randsburg to Rand, *K. Brandegee;* Mojave, *Eastwood* 3184; Willow Springs, *F. Grinnell* 427,443; Antelope Valley, *Grinnell;* Lancaster, *Elmer* 3621, *Hall & Chandler* 7388 (non-typical); Palmdale, *Abrams & McGregor* 513; Kramer, *K. Brandegee;* Barstow, *Jepson* 5835; desert near Hesperia, alt. 975 m., *Blake* 9885; Mohave Desert, *Parish* 139, *Pringle* (24 May 1882), *Purpus* 5443; without definite locality, 1876, *Palmer* 219.

Acamptopappus sphaerocephalus (Harv. & Gray) A. Gray can be divided readily into two varieties with definite characters and definite geographical range. The plant growing in southern Utah, western Arizona, extreme southwestern Nevada (*Goodding* 1423, from Bunkerville, which is in Nevada, not Utah as printed on the label), and the Colorado Desert region has glabrous stems and branches, and the leaves are glabrous or hispidulous-ciliolate. This is the typical form, originally described, under the name *Aplopappus sphaerocephalus* Harv. & Gray, as "fruticosa ? glabra." The type was collected by Thomas Coulter in "California." The other form (var. *hirtellus*) with hirtellous stem, branches, and leaves, ranges from Antelope Valley, in the western part of the Mohave Desert, east to Kramer and north to Lone Pine, Inyo County.

Acamptopappus microcephalus Jones, the description of which suggests the variety here described, is shown by the type collection to be *Aplopappus cooperi* (A. Gray) Hall.

Erigeron inornatus forma **subradiatus** Blake, forma nov.

Heads with about 7–11 pale yellow imperfectly developed rays 6.5–7 mm. long (tube 1.5–1.8 mm., throat 2–3.2 mm., lamina elliptic, concave, spreading,

usually 3-denticulate, 2.2–3.3 mm. long), pistillate and bearing 3–5 abortive and separated stamens.

CALIFORNIA: Along path in dry woods, Tahoe Tavern, Eldorado County, alt. 1900 m., 15 Aug. 1927, *S. F. Blake* 10302 (type no. 1,436,302, U. S. Nat. Herb.).

Erigeron inornatus A. Gray is one of several western species of *Erigeron* which have hitherto been supposed to have always discoid heads. The present plant, a colony of which I found growing in company with discoid plants (no. 10301) near the shore of Lake Tahoe, is consequently of considerable interest. Both the subradiate and discoid plants found here represent the var. *viscidulus* A. Gray rather than the typical glabrous form of *E. inornatus*, having the stem (short-hirsute below) and leaves hirsutulous and the involucre evidently glandular.

Lessingia leptoclada var. **arachnoidea** (Greene) Blake.

Lessingia arachnoidea Greene, Leaflets **2**: 29. 1910.

This variety, characterized by its very short pappus (only 1–1.5 mm. long, that of the typical form being 3.5–6 mm. long), is known only from the vicinity of Crystal Springs Lake, San Mateo County, California, where it occurs to the exclusion of typical *L. leptoclada* A. Gray.

Archibaccharis standleyi Blake, sp. nov.

Erect, suffrutescent; stem subsimple, somewhat zigzag, leafy, densely and finely puberulous with several-celled, conical, spreading or incurved, brownish hairs; leaves ovate, acuminate, rounded at base, short-petioled, chartaceous, mucronulate-serrulate, finely hispidulous, scabrid above, gland-dotted beneath; staminate heads 4–5 mm. high, slender-pediceled, in small panicles at tip of stem and the few branches, 9–20-flowered.

Stem 35 cm.–1 m. high, 1–3 mm. thick, subterete or somewhat round-angled; internodes 8–15 mm. long; leaves alternate; petioles naked, 1.5–3 mm. long; blades ovate or lance-ovate, 2–5.5 cm. long, 1–2.5 cm. wide (smaller toward base of stem), acuminate, somewhat falcate, apiculate (apiculus 0.8–1.5 mm. long), at base rounded or subcordate, near middle mucronulate-serrulate or shallowly crenate-serrate (teeth about 6 pairs, very depressed, 2–6 mm. apart, the curved callous mucros about 0.5 mm. long), firmly chartaceous, above rather densely antrorse-hispidulous, beneath slightly lighter green, similarly but less densely and more softly hispidulous and rather densely gland-dotted, feather-veined and prominulous-reticulate on both sides, the chief lateral veins 4–5 pairs, sometimes impressed above, prominent beneath; heads about 6–10, in convex panicles 2–4 cm. wide, the filiform straightish pedicels 5–10 mm. long, puberulous like the stem, the bracts of inflorescence minute, linear-subulate, mostly 2 mm. long or less; involucre campanulate, 4–6-seriate, 3 mm. high, the phyllaries lanceolate to lance-linear, acuminate, with greenish center and narrow scarious margin, often purplish-tipped, erect, rather densely antrorse-puberulous and gland-dotted; pistillate flowers 2–5, their corollas whitish, sparsely pubescent with somewhat clavate hairs, 4 mm. long (tube 3–3.3 mm. long, ligule erect, concave, minutely 2–3-denticulate, 0.7–1 mm. long), much shorter than style, the achenes (immature) hispidulous, 1 mm. long, the pappus whitish, 4 mm. long, the bristles finely hispidulous-denticulate, not clavate; hermaphrodite flowers 7–15, their corollas whitish, puberulous, 5.2 mm. long (tube 2.2 mm., throat essentially absent, teeth linear, acute 3 mm. long), the achenes hispidulous,

1 mm. long, the pappus whitish, 4.5 mm. long, the bristles denticulate-hispidulous, slightly clavellate at apex; style branches oblong, acute, finely hispidulous, erect, 0.8 mm. long.

HONDURAS: Open rocky or brushy banks, vicinity of Siguatepeque, Dept. Comayagua, alt. 1080–1400 m., 14–27 Feb. 1928, *P. C. Standley* 56193 (type no. 1,308,936, U. S. Nat. Herb.), 56356.

This species, of which only the staminate plant is known, is nearest *Archibaccharis hirtella* (DC.) Heering, differing from that species in its erect (not scandent) habit, the very fine and dense puberulence of the stem, the much firmer leaves, and the slightly larger heads. In its combination of erect habit with definitely zigzag stem and small panicles it to some extent breaks down the distinctive characters of the two principal groups into which the small-headed species of the genus are divided.

Trigonospermum hispidulum Blake, sp. nov.

Herb, apparently unbranched, the stem rather densely hispidulous with several-celled, spreading, conical, acute hairs; leaf blades rhombic-ovate, unequally callous-dentate and -denticulate, somewhat hastately so near the basal angle, lepidote-tuberculate-hispidulous above, hispidulous with antrorse hairs beneath, cuneate-decurrent on upper part of petiole; heads small, numerous, in a somewhat rounded panicle; lamina of rays 4–4.5 mm. long.

Stem more than 60 cm. high, purplish brown, below subterete, striatulate, and 4 mm. thick, above sulcate; internodes about 9–11 cm. long; leaves opposite; petioles incurved-pubescent and with longer spreading several-celled hairs, the unmargined part 1.5–2 cm. long, broadened at base and shallowly connate; blades 8.5–11 cm. long (including margined portion of petiole, this 1.5–4 cm. long) 4.5–6.5 cm. wide, acute, often short-pointed, at base broadly cuneate-rounded and abruptly cuneate-decurrent on petiole, rather thin, dark dull green and in age lepidote-tuberculate above, scarcely paler and gland-dotted beneath, triplinerved from base of proper blade, prominulous-reticulate especially beneath; panicle 11 cm. wide, the ascending lower branches about 8 cm. long, densely spreading-hispidulous and with sparser stipitate yellowish glands, the pedicels 4 mm. long or less; involucre 2-seriate, subequal, 3 mm. high, the outer phyllaries 5, subherbaceous, oblong or ovate-oblong, obtusely callous-tipped, 3-nerved, the inner broader and thinner, ovate, acute or acuminate, all yellowish green, finely and rather densely hispidulous and ciliolate; rays 7, golden, fertile, hispidulous and stipitate-glandular on tube and back, the tube 0.7 mm. long, the lamina quadrate-cuneate, 3-lobed nearly to middle, 4–4.5 mm. long and wide, 9–11-nerved; disk flowers about 26, their corollas 5-toothed, golden, pilose with several-celled hairs and somewhat glandular, 3 mm. long (tube 0.8 mm., throat funnelform-campanulate, 1.7 mm. long, teeth ovate, 0.5 mm. long, papillate especially near margin within); pales lanceolate to linear, acute, ciliate, about 1.5 mm. long; immature ray achenes obovoid, obcompressed, glabrous, 1.3 mm. long; ovaries of disk glabrous; style of disk short-hispid, barely bifid.

MEXICO: On streambank, Hacienda de Ototal, Arroyo de Ototal, west of San Sebastian, Sierra Madre Occidental, Jalisco, alt. 1500 m., 9 March 1927, *Ynez Mexia* 1852 (type no. 1,318,113, U. S. Nat. Herb.).

Allied to *Trigonospermum floribundum* Greenm., in which the stem is more or less densely pilosulous and usually provided with rather dense,

dark, stipitate glands, the leaves rather evenly dentate or denticulate without tendency to hastation, and rays 6–9 mm. long. Only a single plant found.

Echinacea laevigata (Boynton & Beadle) Blake.

Brauneria laevigata Boynton & Beadle in Small, Fl. S. E. U. S. 1261, 1340. 1903.

This species is apparently still known only from the original specimens in the United States National Herbarium collected near Seneca, western South Carolina, in June 1888, by Gerald McCarthy.

Echinacea angustifolia var. tennesseensis (Beadle) Blake.

Brauneria tennesseensis Beadle, Bot. Gaz. **25:** 359. 1898.

In the original description this plant was compared only with *Brauneria pallida* (Nutt.) Britton (= *Echinacea pallida* Nutt.). It is much nearer *Echinacea angustifolia* DC., differing in its generally smaller size, narrower only 1–3-nerved leaves, and spreading-hispid stems and leaves (especially the margins and petioles), but as it intergrades in all these characters it is best considered a variety of that species.

Verbesina microcarpa Blake, sp. nov.

Shrub; stem pubescent; leaves alternate, ovate, acuminate at each end, serrate, rough above with tuberculate-based hairs, beneath griseous-subtomentose, the naked portion of petiole 6–12 mm. long; heads rather small, in an irregular concave cymose panicle, on pedicels mostly twice their length; involucre about 3 mm. high, the oblong-ovate pilosulous phyllaries with reflexed tips; pales spreading-cuspidate; lamina of rays about 7 mm. long.

"Bushy shrub, 2.5 m. high;" branches simple, terete, striatulate, brownish, densely pilose with several-celled, curved, spreading-ascending hairs, these in age mostly deciduous except for the subtuberculate bases; internodes 2.5–4.5 cm. long, wingless; peticles exauriculate, pubescent like the stem; blades 8–11.5 cm. long, 3–4 cm. wide, acuminate, slightly falcate, rounded toward base and then cuneately decurrent on the petiole for 1.5–2 cm., serrate above the entire base with 15–18 pairs of depressed bluntly callous-apiculate teeth, papery, above green, evenly but not densely hirsutulous with antrorse-curved hairs with small tuberculate bases, beneath when young canescently silky-pilose, at maturity uniformly and densely subtomentose-pilose with antrorse-curved hairs, feather-veined (lateral veins 7–9 pairs, prominulous on both sides, the secondaries obsolete); heads about 2 cm. wide, in cymes of about 3 at tips of stem and subterminal branches, forming a convex panicle of about 20 heads, about 11 cm. wide, the pedicels of the terminal heads short, about 5 mm. long, of the lateral 1–2 cm. long, pubescent like the stem, the bracts linear or lance-linear, 1.5 cm. long or less; disk subglobose, 1 cm. thick in mature flower; involucre 2-seriate, 3–4 mm. high, subequal, the outer phyllaries about 5, ovate-oblong, 2 mm. wide, greenish-stramineous, with more herbaceous tips, apiculate, the inner similar to the pales, with reflexed cusps; receptacle small, convex; rays about 10, "lemon-yellow," fertile, the tube pilosulous, 1.5 mm. long, the lamina elliptic, 7 mm. long, 3–3.8 mm. wide, 3-denticulate, 6–8-nerved; disk corollas numerous, "lemon-yellow," pilosulous on tube and base of throat, about 3.4 mm. long (tube 0.6–0.8 mm. long, throat funnelform-campanulate, 1.6–1.8 mm. long, teeth ovate, 1 mm. long, ciliolate on inner margin with long papillae); pales boat-shaped, firm, whitish, hirsutulous above, 4 mm. long, terminated by spreading cusps

about 0.8 mm. long; disk achenes 2.2 mm. long, 1.5–1.8 mm. wide (including wings), the body blackish, tuberculate-hispidulous above, 1.8–2 mm. long, 1–1.2 mm. wide, the wings ciliolate, adnate to base of awns, 0.3–0.5 mm. wide; awns 2, subequal, 1.4 mm. long.

MEXICO: Open oak and pine forest, trail from El Batel to Pico del Aguila, Sierra Madre, Sinaloa, alt. 1220 m., 14 Nov. 1925, *Ynez Mexia* 459 (type no. 141815, herb. Calif. Acad. Sci.; photogr. and fragm., U. S. Nat. Herb.).

A species of the section *Saubinetia*, without striking characters, yet clearly distinct from related species. Of these, *V. seemannii* Sch. Bip. has much narrower leaves (blade about 14 cm. long and 2.5 cm. wide or less), these merely hirsutulous on costa and chief veins beneath, and the shorter involucre is nearly glabrous; *V. liebmannii* Sch. Bip., which vacillates between the sections *Verbesinaria* and *Saubinetia*, has leaves very much less pubescent beneath; *V. cinerascens* Robins. & Greenm. has much narrower leaves with much finer pubescence beneath; and *V. olivacea* Klatt, while similar in pubescence of lower leaf surface, has considerably larger heads and larger involucre.

Zexmenia melastomacea Blake, sp. nov.

Suffrutescent; stem spreading-hispid or -hirsute; leaves ovate, acute, rounded at base, serrulate, short-petioled, harsh-pubescent above, more densely pubescent beneath, 3–5-plinerved, impressed-veined and more or less bullate above, prominulous-reticulate beneath; heads radiate, golden yellow, medium-sized, 1–4 at tips of stem and branches, on peduncles usually 1.5 cm. long or less, occasionally to 3.5 cm.; involucre about 3-seriate, 7–9 mm. high, the phyllaries mostly oblong, densely strigose, with squarrose deltoid herbaceous tips; achenes neither winged nor definitely margined, their pappus of 2 or 3 awns, and 2–7 squamellae about 1 mm. long.

Erect, about 0.5–1 m. high, with erectish or divergent branches; stem gray-barked below and 4 mm. thick, subangulate, densely or sometimes rather sparsely spreading-hispid or hirsute, particularly at the nodes, with several-celled whitish hairs up to 2.5 mm. long; internodes 3.5–12 cm. long; leaves opposite; petioles naked, sulcate above, hispid or hirsute and hispidulous, 3–7 mm. long; blades ovate or broadly ovate, or the smaller ones suborbicular, 3–6.5 cm. long, 1.5–3.8 cm. wide, mucronulate-serrulate except toward base and apex with 5–8 pairs of small teeth, above hispid and hispidulous with tuberculate-based hairs, beneath paler green or griseous, densely strigose, strigose-hispid, or rather softly hispid-hirsute (the hairs longer along the veins); peduncles stoutish, strigose or antrorse-hirsute, usually shorter than the subtending leaves; involucre campanulate, the phyllaries oblong or oblong-ovate, 2–3.5 mm. wide, the body indurated-subherbaceous, the deltoid acutish tips (2–3 mm. long) squarrose except in the inmost phyllaries, these with subscarious ciliolate but otherwise glabrous purplish margin below; rays about 8, pistillate, the tube glabrous, 2.5 mm. long, the lamina oval, about 12 mm. long, 7 mm. wide, 2-denticulate, about 18-nerved, hirsute and hirsutulous on back; disk flowers rather numerous, their corollas glabrous except for the appressed-hirsutulous, papillose-margined teeth, 7.3 mm. long (tube 2 mm., throat cylindric-funnelform, 3.5 mm., teeth ovate, 1.8 mm.); pales firm, acute, purplish above, finely ciliolate, on back above stigillose and sparsely hispid, about 10 mm. long; ray achenes trigonous, not winged,

hispidulous, 5 mm. long, their pappus of 3 lanceolate trigonous ciliolate awns 2–3.8 mm. long and about 4–7 basally united, oblong or triangular, ciliolate squamellae 1–1.5 mm. long; disk achenes cuneate-oblong, 4-angled, 4.3 mm. long, 1.3 mm. wide, tuberculate-hispidulous, their pappus of 2 unequal hispidulous-ciliolate awns 2.5–4.2 mm. long, and 2 broad ciliolate squamellae 1 mm. long; style branches linear, somewhat enlarged toward the tip of the stigmatic region and there dorsally hirsute, the linear appendages 1 mm. long, hispidulous above.

HONDURAS: In pine forests, vicinity of Siguatepeque, Dept. Comayagua, alt. 1080–1400 m., 14–27 Feb. 1928, *P. C. Standley* 56389 (type no. 1,308,960, U. S. Nat. Herb.), 55826.

Nearest *Zexmenia michoacana* Blake, but quite distinct in involucral and other characters. The two collections referred here differ in density or at least in degree of persistence of stem pubescence and in density and character of leaf pubescence, but undoubtedly represent a single species.

Coreopsis congregata Blake sp. nov.

Low, slender, erect, nearly simple, sparsely pubescent annual; leaves opposite, nearly uniform, shorter than internodes, short-petioled, once or twice pinnatifid, with mostly oblong or ovate lobes; heads small, few, yellow; phyllaries pilose; rays neutral, inner disk flowers apparently infertile; outer disk achenes small, obovoid-meniscoid, with narrow, thick, incurved, lobed, crustaceous margin; pappus none.

Stem 13–32 cm. high, whitish, sulcate-striate, sparsely pilose especially above with chiefly ascending hairs; internodes 2–5 cm. long; leaves about 5 pairs, the lower (shrivelled) about 3 cm. long (including petiole, this about 0.7 cm. long), pilose especially on petiole (the hairs there longer and flatter), apparently bipinnatifid; the middle and upper short-petioled or subsessile, triangular in outline, 1.8–3.5 cm. long, 1.2–2 cm. wide, acute, cuneate-rounded at base, deeply pinnatifid with 2–4 pairs of lobes, these oblong to ovate or lance-ovate, acute or obtuse, callous-mucronulate, the lowest pair nearly separate from the others and entire or similarly pinnatifid, all thin, green and pilose on both sides; heads 1–7 per stem, solitary or in 2's or 3's from the axils of reduced leaves at tip of stem and the few erect branches, 2 cm. wide or less; peduncles very slender, naked or with 1–2 very small bracts, 2–5 cm. long, pubescent like the stem; disk about 5 mm. high and thick; involucre double, reflexed in age, the outer phyllaries 8, thin, herbaceous, narrowly spatulate to linear, obtusely callous-tipped, 2.5–3.5 mm. long, about 0.7 mm. wide, 3-nerved (the middle nerve stronger and darkened), pilose and ciliate with several-celled hairs; inner phyllaries membranous, elliptic-oblong, 4.5–4.8 mm. long, about 1.8 mm. wide, obtusely pointed, golden-yellow, sparsely pilose on back, ciliolate at apex, 5–7-nerved; receptacle small, flattish; rays 8, golden yellow, neutral, the tube about 0.7 mm. long, stipitate-glandular, the lamina elliptic-oblong, subentire, 5-nerved, 5.5–6.5 mm. long, 2.5–2.8 mm. wide; disk flowers 15 or more, their corollas golden yellow, stipitate-glandular on tube, papillate on inner margin of teeth, 2.5–2.8 mm. long (tube 0.7–1 mm., throat campanulate, 1.5 mm., teeth deltoid, 0.3–0.5 mm.); pales linear, acutish or obtuse, glabrous, yellow, about 4-vittate, about 3.5 mm. long; outer disk achenes slightly depressed at apex, 2–2.3 mm. long, 1.3–1.5 mm. wide, glabrous, dark brownish or mottled, on outer face smooth or slightly blunt-muricate above, on inner face calloused at base, 1-ridged

and crustaceous-mamillate, the thickened brownish margin (about 0.3 mm. wide) longitudinally rugulose, sinuate below, above divided into a few rounded lobes; inner disk achenes slender, about 2.2 mm. long, with small imperfectly developed embryo; style branches broadened and dorsally hispid above, passing into a papillate cusp 0.2 mm. long.

MEXICO: Common, growing in masses, in damp places in openings in oak and pine forests, trail from El Batel to Pica del Aguila, Sierra Madre, Sinaloa, alt. 1220 m., 14 Nov. 1925, *Ynez Mexia* 445 (type in Gray Herb.; photogr. and fragm., U. S. Nat. Herb.).

A species belonging to the section *Leachia*, without any very close ally.

Plummera ambigens Blake, sp. nov.

Ray achenes villous with straight hairs, and with a pappus of about 6 unequal, oblong, obtuse, lacerate, ribless, hyaline squamellae about 1 mm. long; disk achenes usually trigonous, thicker than in *P. floribunda*, with evident but imperfect ovule, villous with straight hairs and with a pappus of about 4 or 5 unequal, oblong or lanceolate, obtuse to acuminate, lacerate, ribless hyaline squamellae 0.5–1.3 mm. long; style branches of disk with stigmatic lines; otherwise as in *P. floribunda* A. Gray.

ARIZONA: Fairly common on lower slopes of Mt. Graham, about 1370 m. alt., 22 July 1927, *R. H. Peebles, T. H. Kearney, & G. J. Harrison* 4395 (type no. 1,436,073, U. S. Nat. Herb.).

Plummera floribunda A. Gray, the only member of the genus hitherto known, is one of the rarest of United States Asteraceae in herbaria. In it both the ray and disk achenes are completely without pappus and are loosely villous with flexuous hairs, the disk achenes are stipitiform and without trace of embryo, and the style branches of the disk lack any trace of stigmatic lines. Aside from the achenes, pappus, and style branches *P. ambigens* is so precisely similar to *P. floribunda* that I have been unable to find any distinctive characters. The pedicels and young tips are more hairy—essentially cinereous-tomentose—than in the two collections of *P. floribunda* available for comparison, and the inner phyllaries more strongly ciliate and more abruptly cuspidate, but these slight differences are not likely to prove constant when more material is examined. The differences between the somewhat more obovoid ray achene of *P. floribunda*, with its rather definite stipitiform base or carpopod, and that of *P. ambigens* are probably due to the greater maturity of the former. The presence of a well developed pappus in *P. ambigens* and and the tendency toward fertility of the disk flowers, however, not only sharply differentiate the new plant from *P. floribunda* but tend to break down the gap between the section of *Actinea* often separated as a distinct genus *Hymenoxys* and the hitherto well distinguished genus *Plummera*.

Plummera was placed by Gray[4] in the Helianthoideae-Millerieae, although he recognized[5] that "the natural affinity of this plant may rather be with Actinella [= Actinea] in the Helenioideae." O. Hoffmann[6] put it in the

[4] Syn. Fl. 1^2: 59, 237. 1884.

[5] Proc. Amer. Acad. 17: 215. 1882.

[6] In Engler & Prantl, Nat. Pflanzenfam. 4^5: 263. 1890.

Fig. 1. *Plummera ambigens* Blake and *P. floribunda* A. Gray.—*Plummera ambigens* (a-i): a, plant ×½; b, head, ×5; c, ray flower, ×5; d, disk flower, ×5; e, ray achene, ×5; f, disk achene, ×5; g, inner phyllary, ×5; h, style branches, ×7; i, stamens, ×5; *Plummera floribunda*: j, ray flower, ×5; k, disk flower, ×5; l, ray achene, × 5; m, stamens, ×5; n, style branches, ×7.

Helenieae-Heleninae between *Gaillardia* and *Blennosperma* and in the neighborhood of *Actinella*, and more recently Rydberg[7] has placed it in what is unquestionably its proper position next to *Hymenoxys*, in the group he calls Helenieae-Tetraneuranae. From *Hymenoxys*, which I regard as a group to be included under *Actinea*, the genus *Plummera* as represented by its type, *P. floribunda*, differs chiefly in its few-flowered heads, sterile disk, absence of pappus, and obovoid (not obpyramidal), somewhat obcompressed, many-ribbed ray achenes. The first of these characters is here of no more than specific value, the second is weakened by the new species, and the third now disappears. For the present it seems advisable to retain *Plummera* as a genus distinguished by its nearly or quite sterile disk and different ray achenes and to regard *P. ambigens* as specifically distinct from *P. floribunda*, while recognizing that further collections are likely to show that it is no more than a pappiferous variety of the latter.

The ray achenes of *Plummera floribunda* are described by Gray as turgid and nearly nerveless, and by Rydberg as "cuneate-obovoid, villous." Mature achenes on Lemmon's plant (no. 352) are obovoid, elliptical in cross-section, and definitely about 15-ribbed with low blunt ribs. Those of *P. ambigens* are also about 15-ribbed.

Eriophyllum wallacei var. **calvescens** Blake, var. nov.

Pappus in both ray and disk reduced to a mere border, 0.1 mm. high or less, about 5-lobed or parted; otherwise as in the typical form.

CALIFORNIA: Lone Pine, 16 April 1891, *T. S. Brandege*; north of and near Victorville, Mohave Desert, 11 May 1926, *M. E. Jones* (type no. 1,436,074, U. S. National Herb.); desert near Hesperia, 14 June 1927, *S. F. Blake* 9881A; mesas, San Bernardino Valley, May 1882, *S. B. & W. F. Parish* 348 in part.

The pappus in *Eriophyllum wallacei* A. Gray normally consists of about 6 to 10 blunt opaque white squamellae or paleae 0.5–1.2 mm. long. In the form here described, which sometimes, apparently, occurs by itself and at others with the typical form and intergrading with it, the pappus is so reduced as to be evident only on close examination. It has already been mentioned by Dr. H. M. Hall[8] from the Santa Ana River bottoms near Redlands (*F. M. Reed* 784 and *Greata* 572 in part).

Actinea subintegra (Cockerell) Blake.

Hymenoxys subintegra Cockerell, Bull. Torrey Club **31**: 480. *pl.* 22, *f. 1.* 1904.

This apparently well-marked species, which, according to Rydberg's treatment,[9] has been known only from the type locality, Nagle's ranch, Arizona, was collected in the upper drainage of North Canyon, Kaibab National Forest, Coconino County, Arizona, altitude 2440 meters, 30 July 1926, by Leon W. Hornkohl (no. 35; specimen in Forest Service Herbarium).

[7] N. Amer. Fl. **34**: 118. 1915.

[8] Univ. Calif. Publ. Bot. **3**: 182. 1907.

[9] N. Amer. Fl. **34**: 116. 1915.

It has also been collected near Jacobs Lake, Kaibab National Forest, 14 August 1926 (specimens received through Dr. C. D. Marsh). Prof. M. E. Jones informs me that Nagle's Ranch, the type locality, is about 60 miles south of Kanab, Utah, on the west slope of the Buckskin Mountains (i.e., the Kaibab plateau), and was the first watering place on the old wagon road to the Grand Canyon from Kanab. The old Valley Tan ranch was about 15 miles further up on the plateau, and was the first ranch reached on the way to the Canyon after ascending the plateau. The present wagon road now ascends the plateau many miles farther north. The term Buckskin Mountains, as applied to the Kaibab Plateau, is now obsolete. Recent maps of the state show another range of the same name just south of Williams River (Bill Williams Fork).

Cacalia eriocarpa Blake, sp. nov.

Scapose, about 85 cm. high; leaves orbicular, peltate, about 14 cm. wide, hirsute-pilose, shallowly about 6-lobed, the lobes broader than long, repandly about 3-angled; scape spreading-pilose with many-celled hairs and stipitate-glandular; heads about 12-flowered, apparently erect, in a narrow panicle, on pedicels about 3 times as long; involucre 8–9 mm. high, sparsely pilosulous, essentially without bractlets; achenes densely silky-pilose.

Rootstock short and stout, bearing tufts of rusty wool, and clustered slender roots; well developed basal leaves 2, with an abortive one; petioles stout, 3–6 cm. long, very densely spreading-pilose with loose many-celled hairs; blades firm, peltate below middle, prominulous-reticulate especially beneath, above deep green, pilose with many-celled hairs with somewhat swollen bases, beneath lighter green, somewhat lucid, pilose on venation with loose many-celled hairs; scape subterete, striatulate, 4 mm. thick below, densely pilose toward base, sparsely so above, bearing 2 bracteiform leaves 1.5 cm. long or less, their blades tiny or none; panicle about 35 cm. long, about 28-headed, the slender erectish branches 11 cm. long or less, about 3-headed, subtended by linear bracts 9 mm. long or less; pedicels slender, mostly 2–3 cm. long, thickened toward head, bearing mostly above middle 3–6 minute erectish linear-subulate bracts 2 mm. long or less; involucre naked at base or occasionally with 1 approximate bract like those of the pedicel, the phyllaries 8, linear or lance-linear, 1.5–2 mm. wide, narrowed to an obtuse ciliolate apex, about 5–7-nerved, green or purplish on their exposed parts and there short-pilose with several-celled hairs especially toward apex, and sparsely stipitate-glandular, the inner with rather broad whitish subscarious margins; corollas white, glabrous, 9.2 mm. long (tube 4.2 mm., throat campanulate, 0.8 mm., teeth nearly linear, acutish, recurved, 3-nerved, 4.2 mm. long); achenes 3.8 mm. long; pappus copious, white, 8 mm. long, the minutely barbellate bristles united at extreme base, a few of the outer about 1.8 mm. long; style branches elongate, linear, recurved, hispidulous on back especially toward the rounded unappendaged apex.

MEXICO: Steep slopes in open pine and oak woods, Arroyo de Santa Gertrudis, San Sebastian, Jalisco, alt. 1500 m., 21 Jan. 1927, *Ynez Mexia* 1539 (type no. 1,406,195, U. S. Nat. Herb.).

A species of the group which Rydberg[10] recognizes as a distinct genus, *Psacalium* Cass. *Cacalia eriocarpa* is rather closely allied to *C. holwayana* Robinson (*Psacalium holwayanum* Rydb.), of which *P. langlassei* Rydb. is a

[10] Bull. Torrey Club **51**: 370–376. 1924.

synonym, as shown beyond. *Cacalia holwayana* is similar in habit, foliage, and pubescence to *C. eriocarpa*, but its heads are much larger (involucre 10–13 mm. long), normally strongly nodding, clustered or racemosely arranged toward tips of branches on much shorter pedicels, and the bractlets of the involucre or thickened tip of pedicel are conspicuous, linear-subulate, 4–9 mm. long.

Langlassé 576 is cited by Dr. Rydberg under both the first (*P. holwayanum*) and the last (*P. langlassei* Rydb., described as a new species) of his 14 species of *Psacalium*. Both come in his key in the group with strongly pubescent involucre, and are separated to this distance by the use of a character drawn from the "deeply cleft" or "sinuately lobed" leaves. Through the kindness of Dr. B. L. Robinson, it has been possible for me to compare the specimen in the National Herbarium (no. 386047) which is the type of *P. langlassei* with the specimen of the same number in the Gray Herbarium, which is apparently the one referred by Dr. Rydberg to *P. holwayanum*. The specimen in the National Herbarium differs from the one in the Gray Herbarium in its apparently erect heads and somewhat more shallowly lobed leaves (with sinuses 1–2 cm. deep; in the Gray Herbarium specimen 1.8–3.5 cm. deep), but their entire agreement in all other characters, including the very definite ones of involucre and achene, makes it certain that they represent the same species. The achenes of *P. holwayanum* are described by Dr. Rydberg as tomentulose, but are really densely short-hirsute with erectish or subappressed hairs.

Cacalia trigonophylla Blake, sp. nov.

Stem slender, from a tuberous root, few-leaved near middle, glabrous and glaucous throughout; lower leaves pentagonal, cordate, sharply 5-lobed, remotely callous-denticulate, the middle ones similar but trigonous, hastate-cordate, green above, strongly glaucous beneath, glabrous, all long-petioled, 4.5–6.5 cm. wide; heads 3–4, subracemose, discoid, about 29-flowered; involucre 8–9 mm. high, glabrous; bractlets about 1 mm. long.

Root about 1.5 cm. long, 0.9 cm. thick; stems apparently solitary, somewhat flexuous, 43–58 cm. high, about 6-leaved, whitish, more or less purplish-tinged and -lined; petioles unmargined, glabrous, 4–7.5 cm. long; leaf blades chartaceous, prominulous-reticulate above, less closely so beneath, repand between the lobes, 3.2–4.5 cm. long; the uppermost one or two much smaller, 3-lobed, 2.5 cm. wide or less; inflorescence about 9 cm. long, the slender peduncles 1-headed, 3–3.5 cm. long, minutely few-bracted, subtended by filiform bracts 5 mm. long or less; involucre thick-cylindric, subtended by about 10 linear acute fleshy bractlets 1.3 mm. long or less, the phyllaries 13, linear or lance-linear, 1–1.8 mm. wide, obtuse, ciliolate at apex, otherwise glabrous, thickened at base and along midline, greenish and glaucescent, with narrow subscarious whitish margins; corollas white, at maturity 10 mm. long, the tube 3.5 mm. long, the slender funnel-form throat 4 mm. long, the recoiled lance-linear acute teeth (1-nerved in middle) 2.5 mm. long; achenes oblong-prismatic, 10-ribbed, glabrous, 2.5 mm. long, about 1 mm. thick; pappus soft, white, about 7 mm. long, the bristles slightly thickened at apex, rather easily deciduous except for the extreme bases which form a minutely denticulate

collar at apex of achene; style branches truncate-rounded, of medium length, hispidulous on back, without obviously penicillate tip.

MEXICO: In dense growth beside stream on steep hillside, San Sebastian, trail to La Sabala Mine, Sierra Madre Occidental, Jalisco, alt. 1500 m., 10 Feb. 1927, *Ynez Mexia* 1656 (type no. 1,318,107, U. S. Nat. Herb.).

This species is a member of the group of the old genus *Cacalia* for which Dr. Rydberg has adopted the name *Pericalia* Cass. Its only close relative is *Cacalia michoacana* Robinson, a species of very similar habit but with the stem pilose from base to middle with many-celled, crisped hairs, the petioles and veins of the leaves similarly pubescent, the leaves all 5 (–7)-lobed and not glaucous beneath, and the bractlets of the involucre 3–6 mm. long.

ZOOLOGY.—*A new antelope squirrel from Lower California.*[1] E. W. NELSON and E. A. GOLDMAN, U. S. Biological Survey.

Recent field work in Lower California and the publication of the description of *Ammospermophilus leucurus canfieldae* by Laurence M. Huey,[2] Curator of Birds and Mammals, San Diego Society of Natural History, have contributed materially to knowledge of the antelope squirrels of the central part of the peninsula. Further study of these ground squirrels, which range the entire length of Lower California, has led to the segregation of a more southern subspecies described as follows:

Ammospermophilus leucurus extimus, subsp. nov.

Southern Peninsular Antelope Squirrel

Type.—From Saccaton, 15 miles north of Cape San Lucas, Lower California, Mexico. No. 146587, ♀ adult, U. S. National Museum (Biological Survey collection), collected by E. W. Nelson and E. A. Goldman, December 29, 1905. Original number, 18805.

Distribution.—Ranging from sea level to about 1,000 feet altitude on the slopes of the mountains from about latitude 28°; south to Cape San Lucas, except in Vizcaino Desert region.

General characters.—Most closely allied to *Ammospermophilus leucurus canfieldae*, but larger; color darker, usually with a near mikado brown (Ridgway, 1912) instead of vinaceous cinnamon suffusion; winter pelage shorter, thinner, more hispid; skull larger, but in detail essentially as in *canfieldae*. Similar to *A. l. peninsulae* in color but upper parts with a mikado brownish instead of a more or less distinctly orange cinnamon suffusion, and cranial characters distinctive. Differing from *A. l. leucurus* in darker color, longer tail and cranial details.

Color.—*Type:* Upper parts in general light mikado brown moderately mixed with black, except on outer sides of limbs and shoulders where the mikado brownish element is nearly pure, interrupted by the usual white

[1] Received May 27, 1929.

[2] Trans. San Diego Soc. Nat. Hist. 5(15): 243. Feb. 27, 1929.

stripes along upper part of sides; sides of face and neck grayish; back of neck and area between shoulders with a grayish admixture producing a distinctly grizzled effect; under parts and inner sides of limbs dull whitish, this color extending well up but ending abruptly along sides of body; hind feet vinaceous cinnamon along outer sides to toes, the inner sides and toes whitish; tail above mixed black and white, with a mikado brownish suffusion near base, below dull white along middle, the hairs along sides with a broad subterminal black zone, and white tips. Some specimens are paler and grayer in general color, the outer sides of hind limbs varying to near vinaceous cinnamon.

Skull.—Closely resembling that of *A. l. canfieldae*, but larger; auditory bullae small and interpterygoid fossa wide about as in *canfieldae*. Similar to that of *A. l. peninsulae* in size, but auditory bullae usually much smaller. Differing from typical *leucurus* in larger size, broader interpterygoid fossa, smaller auditory bullae and heavier dentition.

Measurements.—*Type:* Total length, 228 mm.; tail vertebrae, 80; hind foot, 37. Two adult topotypes, respectively, 222, 228; 80, 83; 37, 38. *Skull* (type): Greatest length, 40; condylobasal length, 37.1; zygomatic breadth, 23.1; breadth of braincase (at notch behind zygomata), 18.5; interorbital breadth, 10.4; least postorbital breadth, 14.6; length of nasals, 12.1; maxillary toothrow, 7.2.

Remarks.—*Ammospermophilus l. canfieldae* occupies the extremely arid central section of the peninsula of Lower California, including the Vizcaino Desert, intergrading to the north with *A. l. leucurus* and *A. l. peninsulae.* It is somewhat intermediate in color and differs from both of the more northern forms in cranial details, as pointed out by its describer.

To the east, and southward of the Vizcaino Desert region to Cape San Lucas, much of the land surface of the peninsula consists of rugged lava beds and mountains of moderate elevation, with broad level plains only in the vicinity of Magdalena Bay, and extending across to the Gulf side at La Paz. This generally broken southern section is inhabited by the new form, *A. l. extimus,* here described. It more nearly resembles *peninsulae* than the nearer geographic neighbor *canfieldae* in color, but differs in tone as pointed out. Some specimens from the desert plain near La Paz are paler than usual in the subspecies, but others agree closely with topotypes. Specimens from the type locality and elsewhere indicate that *extimus*, the most southern form of the genus, wears a short, rather bristly coat throughout the year instead of acquiring the long, full, soft and especially on the underparts, somewhat silky winter pelage common to the more northern subspecies.

Specimens examined.—Total number, 56, from Lower California, as follows: Aguaje de San Esteban, 1; Cape San Lucas, 9; Comondu, 9; El Potrero (near Mulege), 2; Guajademi, 1; La Paz, 4; Matancita, 1; Saccaton (type locality 15 miles north of Cape San Lucas), 4; San Bruno, 1; San Ignacio, 6; San Jose (30 miles north of La Purisima), 2; San Jose del Cobo, 5; San Juanico Bay, 2; San Pablo, 6; Santana, 3.

ZOOLOGY.—*Observations on the morphology and physiology of nemas; including notes on new species.*[1] N. A. COBB, United States Department of Agriculture.

1. A NEW SUBGENUS OF RHABDITIS

There is a group of slender-tailed amphigonic rhabdites having lips and pharynx as shown in Fig. 1, the males of which have weakly developed bursas. Such rhabdites have been described from time to time but no author seems to have had adequate material for a completely satisfactory description. Having examined living specimens of both sexes of a new species of this group I took the occasion to prepare a fuller description of it, and propose it as the type of **Rhabditella,** a *new subgenus* of the genus Rhabditis Dujardin 1845.

Rhabditis (Rhabditella) leptura n. sp. $\frac{2.3}{1.8}\cdots\frac{13.}{3.1}\cdots\frac{20.}{3.4}\cdots\frac{^{13}45.^{715}}{3.9}\cdots\frac{71.}{2.2}$ 0.82 mm Thin layers of the transparent, colorless, naked cuticle are traversed by excessively fine, plain, transverse striae, resolvable only with the highest powers. Longitudinal striations, due to the attachment of the musculature, are visible in most regions of the body. No deirids have been observed. The neck is very slightly conoid. The cross section of the pharynx is roundish-triangular; yet the almost imperceptibly sigmoid pharynx is nearly equidiametral throughout, though anteriorly the walls are a trifle more strongly refractive. The glottis is a trifle oblique, but otherwise fairly typical. The oesophagus presents a median, fairly prominent, ellipsoidal swelling, or bulb, two-thirds as wide as the middle of the neck, and a somewhat ellipsoidal, or obscurely pyriform posterior bulb two-thirds as wide as the base of the neck,—both swellings of approximately the same diameter. The median swelling presents an elongated, obscure but rather large, valvular apparatus, while the cardiac bulb presents a rather strongly refractive, somewhat three-fold, striated valvular apparatus, located a little in front of the middle of the bulb. At the nerve-ring the oesophagus is one-third, and in front of the cardiac bulb about one-fourth as wide as the corresponding portion of the neck. There is a distinct cardiac collum constituting a rather broad constriction, so that the anterior portion of the intestine through a distance nearly equal to one body-width enlarges from about one-third to five-sixths as wide as the body. This appearance, however, is somewhat variable. The nerve-ring surrounds the oesophagus obliquely. The intestine, the lining of which is somewhat refractive, is made up of cells of such size that probably only about two are presented in each cross section; these cells contain granules of variable size, which are not strongly birefringent. With crossed nicols there is no suggestion of a St. Andrew's cross;—not at all like the strong birefringence of *R. monohystera.* The posterior lip of the anus is very slightly raised. The rectum, whose lining is only slightly refractive, is one and one-

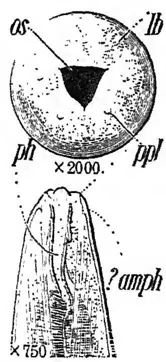


Fig. 1. Front and dorsal view of the head of *Rhabditella leptura.* The beginning of the oesophagus is shown in the lower illustration.

third times as long as the anal body diameter. The vulva is slightly depressed, though its lips are slightly elevated. The ovaries extend two-thirds the distance back to the vulva, and are only about one-sixth as wide as the body of the female. The smooth, thin-shelled, ellipsoidal eggs, about as long as the body is wide and two-thirds as wide as long, have been seen in the uteri one at a time. Their yolk is made up of closely packed, faintly refractive, spherical granules, scattered among which are a few exceedingly small granules less than one micron in diameter.

$\frac{2.3}{2.1} \cdots \frac{16.}{3.8} \cdots \frac{24.}{4.} \cdots\cdots \frac{^{41}M}{4.2} \cdots \frac{73.}{3.1} \, 0.61\,mm$ There are two, equal, separate spicula. The nema must be tipped a little in order to bring the slightly developed obscure bursa into profile view. The foremost papilla, or bursal rib, is somewhat variable in position and is sometimes found nearly as far forward as the proximal ends of the spicula. Fig. 2.

The testis is reflexed at its free end for a distance equal to about two body diameters. This portion of the testis is only about one-fourth as wide as the body, though it is very slightly swollen at its extremity. Behind the flexure for some little distance the testis still remains narrow,—only a little wider than the reflexed portion lying alongside. Then, however, it rather suddenly enlarges and soon becomes half as wide as the body and so continues, enlarging slightly, however, for three or four body widths. In this portion of the testis the spermatocytes pass through their growth period; they appear as if in two rows and in pairs side by side, and one gets the impression that these pairs are twin cells. Their nuclei are large, becoming at last half as wide as the elongated spermatocytes themselves, i.e. one-fifth as wide as the nema. About halfway from the blind end of the testis to the anus the full grown spermatocytes, here half as wide as the body and about as long as wide, apparently break successively into quartets, the resulting subspherical cells being a little more than one-fourth as wide as the body. For a distance equal to about two body diameters forward from the spicula the sexual organ is narrower,—about one-third as wide as the body. Whether the cells of the quartet divide further remains unknown.

Examination of one of the members of a quartet indicated the probable presence of about seven chromosomes.

Habitat: Decaying fruit of *Luffa acutangula* from Tela, Honduras, October, 1926. Sent by Horace S. Dean.

Diagnosis: Rhabditella subg. nov. Rhabdites having lips and pharynx as shown in Fig. 1, the males of which have a weakly developed costate bursa and long slender tails.

Diagnosis: **Rhabditis (Rhabditella) leptura** n. sp. Rhabditellas dimensioned as shown in the formulae; male with two separate spicula, a simple inconspicuous gubernaculum, and with nine bursal ribs arranged as shown in Fig. 2; phasmids present.

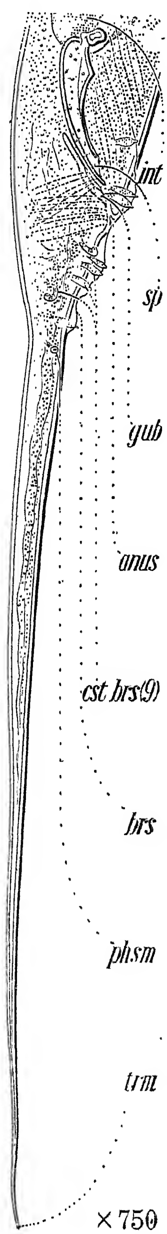


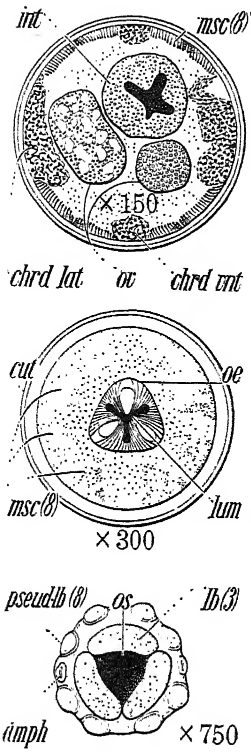
Fig. 2. Tail of male of *Rhabditella leptura* n. sp.

2. MYOLABIA ON A NEMIC PARASITE OF MILLIPEDS

The front view of the lip region of *Thelastoma attenuatum* Leidy, a nema from the intestine of the milliped *Sporobolus marginatus*, gives the impression at first that there is a circlet of 10 "lobes" surrounding the usual three lips. Careful scrutiny shows that two of these ten lobes, the lateral ones, are the external amphids. This leaves 8 other lobes arranged in 4 submedian pairs.

A similar condition exists on another, and new, species of Thelastoma occurring in the same host, except that in this new nema the amphidial lobes do not so closely resemble the other 8. Fig. 3. In the new species the first slice behind the lip region discloses the anterior parts of 8 muscular fields that extend throughout the body, as may be shown by cross sectioning. Fig. 3. Furthermore, it is quite evident that the 8 labial "lobes" are the external cephalic expression of these 8 longitudinal muscular fields.

It is therefore very interesting to find that in a second new species of Thelastoma, belonging to a new subgenus and infesting a different host (namely the milliped *Fontaria marginata* Say, as found in Virginia, U. S. A., near the District of Columbia) the 8 organs which in *Thelastoma attenuatum* are rather inconspicuous lobes surrounding the true lips, have *entirely displaced the ordinary lips*, forming a lip region prominently set off by constriction, and consisting of 8 prominent subequal contiguous parts folded completely together over the pharynx and constituting lips of a new sort. Figs. 4 & 5. This Fontaria parasite presents, in cross-section, 8 pairs of muscular fields. Fig. 5.



0.5 8. 18. 26'48.'20 78. / 1.5 4.7 7.5 9.4 4.6 2.8mm

Fig. 3. Measurements, front view of the lip region and nearby cross-sections of *Thelastoma (Thelastoma) spicatum* n. sp.

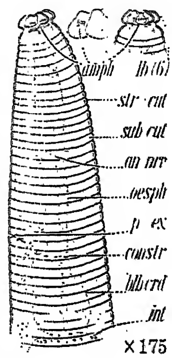
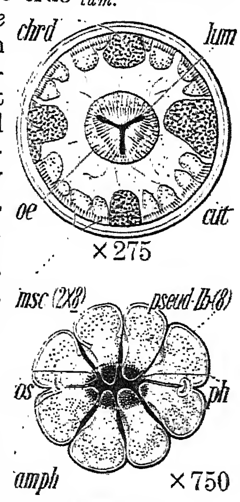


Fig. 4. Profile of head and neck of *Thelastoma (Thelastomellum) myolabiatum.*



0.9 8.8 20. 19'46'12 67. / 2.5 4.9 7.2 7.8 4.7 1.6mm

Fig. 5. Measurements, front view and cervical cross-section of *Thelastoma (Thelastomellum)* subg. nov. L. *myolabiatum.*

These lips may be called *pseudolabia*;—or, because of their connection with the longitudinal muscular fields of the nema, *myolabia*. No cephalic papillae have as yet been seen on these myolabia.

Diagnosis. **Thelastoma (Thelastoma) spicatum** n. sp. Much like *T. attenuatum* Leidy, but smaller and with shorter spicate tail and more completely differentiated, though still rather vague, myolabia. Dimensioned as shown in the formula. Fig. 3. *Attenuatum* and *spicatum* may occur together in the intestine of the milliped, *Sporobolus marginatus.*

Diagnosis. **Thelastomellum** subg. nov. Thelastomas with 8 well-developed myolabia as in Fig. 5. Type species *T. myolabiatum* n. sp.

Diagnosis. **Thelastoma (Thelastomellum) myolabiatum** n. sp. Dimensioned as shown in the formula, and with lips and amphids as in Fig. 5.

3. SYNGONY IN A NEW NEMA FOUND IN MILLIPEDS

Hitherto undescribed nemic parasites found in the intestine of the milliped *Fontaria marginata* Say and belonging to the genus Thelastoma Leidy, prove syngonic. Thelastoma would be assigned by most authors to the group Oxyuridae.

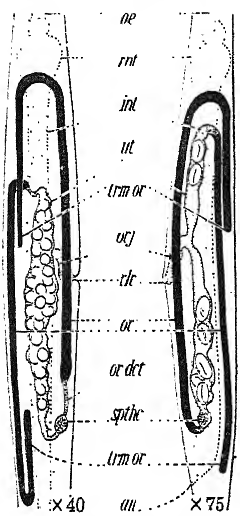


Fig. 6. Slightly diagrammatic drawings of the female gonads of *Thelastoma* (left) and *Thelastomellum* (right). *sp. thc.* spermatheca.

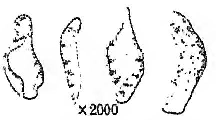


Fig. 7. Scoop shaped syngonic sperms of *Thelastomellum.*

The discovery of syngony in this group opens up an interesting field for speculation and research. It has long been felt that the "Oxyuridae" present many resemblances to the rhabdites. The gonism of the rhabdites has been found very varied, particularly through the researches of Maupas. Query: To what extent, now, will the variations exhibited by the rhabdites be found to occur in the "Oxyuridae?"

Male "oxyurids" usually are less common than the corresponding females, quite frequently are rare, and in some cases are unknown. The striking nature of the recorded sex ratios has been explained by saying that the males, being very much smaller, are easily overlooked, and that possibly they die soon after copulation; and that these two factors,—their smallness and (assumed) relatively early death,—account for their supposed rarity.

In the rhabdites the evidence fully warrants the view that syngony has evolved from amphigony with a gradual diminution or disappearance of males;—for many stages between the two extremes still exist as evidence of the possibility of such a change. Therefore the discovery of syngony in the "oxyurids" at once suggests a new explanation of the scarcity of "oxyurid" males, namely, the one now usually accepted in many cases for the rarity of male rhabdites. If this be true of the "oxyurids," it may have a considerable bearing on veterinary and medical questions connected with "oxyurid" parasites in man and domesticated animals, and in other hosts.

Species that have been assigned to the "Oxyuridae" are common parasites of insects and some other annulata.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

GEOLOGICAL SOCIETY

450TH MEETING

The 450th meeting was held at the Cosmos Club March 13, 1929, President CAPPS presiding.

Program: J. EDWARD HOFFMEISTER and HARRY S. LADD: *Thickness of elevated coral reefs.* The question of the thickness of coral reefs is discussed and new evidence is presented which indicates that many elevated reefs in Tonga and Fiji are not nearly as thick as previously supposed.

A coral reef is defined as a wave resisting structure composed of calcium carbonate secreted by corals and nullipores living in close association. Elevated structures of this type in Tonga and Vitilevu, Fiji do not seem to exceed two hundred feet in thickness. Since reef-building corals can flourish to a depth of two hundred feet such thin reefs can be explained by normal growth without subsidence.

Detailed studies were made of Eua and Vavau in Tonga (the only high limestone islands in the group) and of Vitilevu in Fiji. The main mass of the limestone in these islands is composed of foraminifera. (*Author's abstract.*)

W. C. MANSFIELD: *Some deep wells near the Atlantic Coast in Virginia and the Carolinas.* Study of cuttings from deep wells along the Atlantic Seaboard corroborates the fact, inferred a number of years ago from the surface distribution of the geologic formations, that the region of the Cape Fear River in North Carolina is upwarped. Depths to crystalline bedrock in five wells are as follows: Fort Monroe, Va., 2246 feet; near Havelock, N. C., 2318 feet; Wilmington, N. C., 1109 feet; Fort Caswell, N. C., 1540 feet; Summerville, S. C., 2450 feet. At Havelock and at Summerville the Upper Cretaceous-Eocene contact lies at a depth of about 700 feet below the surface, but at Wilmington it is a few feet above sea level. (*Author's abstract.*)

W. T. SCHALLER and E. P. HENDERSON: *Mineralogy of potash cores from New Mexico and Texas.* This study was based upon a series of core tests drilled by private companies and also the Government. The cores are $2\frac{1}{2}''$ in diameter. Only the economic material is shipped to Washington, thus the study of the mineral associations and relationships is based upon selected horizons.

About 20 minerals have been definitely determined and if the most common are arranged according to their decreasing order of abundance they appear as follows: Halite, anhydrite, clays and shales, polyhalite, sylvite, carnallite. Polyhalite is far the most widespread and abundant potash mineral so far noted.

The saline minerals show many replacements. Polyhalite is found replacing both anhydrite and to a lesser degree halite. Other minerals such as glauberite and leonite are replaced to form polyhalite. Much of the sylvinite shows enrichment by later sylvite.

The striking mineralogical features are (1) rather constant red color of the potash minerals; color caused by hematite; (2) the presence of thin bands of magnesite in the anhydrite rock, clays and also polyhalite; (3) the reoccurrence of mineral cycles; the anhydrite grading into polyhalite, polyhalite into halite, and the halite into sylvinite; (4) many of the minerals show a sequence of formation. (*Author's abstract.*)

451ST MEETING

The 451st meeting was held at the Cosmos Club March 27, 1929, President CAPPS presiding.

Program: W. S. BURBANK: *A collapsed dome in the Bonanza mining district, Colorado.* The Bonanza district lies at the northeastern edge of the volcanic region of the San Juan Mountains of Colorado. The rocks of the district consist of a series of lava flows, probably of Oligocene age, which are invaded by bodies of closely related intrusive rocks. At least 4,000 feet of essentially horizontal lava flows and some local volcanic piles, ranging from augite andesites to rhyolites, accumulated before the invasion of the larger intrusive bodies. These reached to within the shallow portions of the crust, and domed and weakened it until lava escaped to the surface or the intrusive forces became too weak to support the weight of the overlying rock. The arched rocks collapsed over an area of about 100 square miles and subsided upon the underlying magma.

During the subsidence the lavas broke into a complex series of fault blocks, which were at places steeply tilted. It is believed that the tilting and faulting of the lavas occurred simultaneously. The nature of the faults indicate that forces of both compression and tension were involved in the collapse of the structure. The resulting structure was compared to that of the Bullfrog district, Nevada. Following the subsidence of the region hydrothermal alteration of the rocks occurred and base metal veins were formed in many of the fault fissures. Post-mineral deformation was very slight compared to the pre-mineral deformation. (*Author's abstract.*)

Discussed by Messrs. LOUGHLIN, STOSE, G. R. MANSFIELD and GILLULY.

J. B. MERTIE, JR.: *The Pre-Cambrian sequence of Alaska and Yukon Territory with particular reference to the Pelly Gneiss.* The earliest work on the pre-Cambrian of Yukon Territory, Canada, was done by Dawson and McConnell, in 1887 and 1888. These pre-Cambrian studies were continued in Yukon Territory by McConnell, up to 1905, and in Alaska by Hayes, Spurr, and Brooks from 1891 to 1902. McConnell, in 1905, submitted a pre-Cambrian section of the Klondike district, which constitutes the basis of present sub-division and nomenclature. This work was continued in interior Alaska and Yukon Territory, from 1902 to 1912, by Prindle, Capps and Cairnes, and in Seward Peninsula, by Collier, Smith, Brooks and others. More recently, pre-Cambrian studies have been pursued in Yukon Territory by Cockfield and in Alaska by Mertie. The present sub-division of the pre-Cambrian section is as follows:

Alaska	*Yukon Territory*
	Yukon group:
Pelly Gneiss	Pelly Gneiss
Undifferentiated schists of igneous origin	Amphibolites
	Sericites and chlorite schist (Klondike Series)
Birch Creek Schist, of sedimentary origin	Nasina series, of sedimentary origin

The Pelly Gneiss is typically developed in Yukon Territory, and in the valleys of Ladue River and Dennison Fork of Fortymile River in Alaska. It consists mainly of genissoid granitic rocks, ranging in composition from granite to quartz diorite, and passing by differential metamorphism into

feldspathic schists. Augen gneiss is particularly well developed, the augen consisting mainly of orthoclase, in places considerably albitized. Albite is an important constituent among many of the gneisses, occurring in three types as follows: First, original magmatic albite; second, albite and oligoclase-albite, produced by albitization of both orthoclase and plagioclase feldspars; and third, crystalloblastic albite, more often developed in the feldspathic schists.

A somewhat similar formation of altered rhyolitic rocks, known as the Totatlanika Schist occurs south of Tanana River, and the possible correlation of this schist with the surficial phases of the Pelly Gneiss is suggested. The possibility that both these formations may be Paleozoic rather than pre-Cambrian is a contingency not to be overlooked. (*Author's abstract.*)

Discussed by Messrs. MENDENHALL, P. S. SMITH, SCHALLER and PRINDLE.

TAISIA STADNICHENKO: *Microthermal studies of some "mother rocks" of petroleum from Alaska.* Discussed by Messrs. P. S. SMITH, SPENCER, MERTIE, MENDENHALL, WHITE.

452D MEETING

The 452d meeting was held at the Cosmos Club April 10, 1929, President CAPPS presiding.

Informal communications: ROBERT OHRENSCHALL: *Striated river pebbles from Alaska.* Striated pebbles are found in terraces of rivers south of the known limits of Pleistocene glaciation. Similarly scratched pebbles are found in the present channel of the Yukon River, Alaska. It is believed that the striae are caused by the action of rocks held in river ice scouring the channel during the spring "break up." (*Author's abstract.*)

CHARLES MILTON: *Moissanite (natural carborundum) in sediments.* Mr. Milton described an investigation in progress by R. D. Ohrenschall and himself on the widespread though sparing occurrence of moissanite (silicon carbide) in sedimentary rocks, suggesting a cosmic course. Dr. M. I. Goldman in comment cited a French occurrence of diamonds as possibly having a similar extra-terrestrial origin.

W. T. SCHALLER: *A new use for minerals.* The colors of minerals are reproduced in neckties; thus we have patterns in lapis lazuli, sapphire, opal, garnet, malachite, amethyst, etc. Also used as a basis for painting automobiles.

Program: LLOYD W. FISHER: *Origin of chromite deposits.* Chromite as an abundant accessory mineral or as a deposit of commercial importance is restricted to ultrabasic rocks or their derivatives. A comparative study of altered and unaltered chromiferous rocks from all prominent localities shows that chromite may belong to at least three different periods of formation—early or late magmatic, and hydrothermal.

In fresh rocks chromite of early magmatic origin is unfractured and occurs as euhedral or subhedral forms. Crystallization of magmatic chromite and silicates proceeds together after an initial crystallization of the ore minerals. Much of this chromite is resorbed and deposited as late magmatic or hydrothermal chromite.

Chromite of the late magmatic period is often confined to zones of crushed olivine or transects the boundaries of the silicates. It also occurs as elongate forms interstitially between the groundmass minerals. It is usually unfractured and may be subhedral or euhedral in form. This late magmatic chromite, which is of far greater importance than that formed at any other

period, replaces, either partially or completely, the groundmass silicates, and surrounds, embays or cuts these minerals, or penetrates the cleavable minerals.

The chromite of hydrothermally altered rocks may or may not be fractured but the forms are predominantly anhedral. Such chromite is definitely associated with hydrothermal minerals of two distinct periods of crystallization: early—anthophyllite, actinolite, and tremolite; and late—chlorite, talc, serpentine (bastite, antigorite and chrysotile) and magnesite. Chromite of hydrothermal origin occurs interstitially between plates of chlorite and in cleavages of magmatic or early hydrothermal minerals, and in the fibrous zones of bastite and chrysotile. It is difficult, however, to determine quantitatively the amount of chromite deposited along cleavages or interstitially between plates of deuteric minerals by hydrothermal solutions. Such chromite might have been formed during the late magmatic period.

The degree of fracturing of the grains compared with the amount of alteration the rock has undergone, the occurrence of chromite transecting silicate outlines or moulded on their periphery, and the association with hydrothermal minerals as outlined above are criteria for recognition of late chromite.

The type of emplacement of the ore body is suggestive, in part, of chromite being introduced into the country rock. The type of occurrence of the ore body is reflected on a small scale in thin section.

It is indicated that the rôle of hydrothermal solutions as solvents of chromite of early magmatic stage and as transporting agents of late magmatic and hydrothermal chromite is important. (*Author's abstract.*)

Edward H. Watson: *Origin of Maryland pegmatites.* The pegmatites of Maryland are limited to dike swarms within the eastern holocrystalline area of the Piedmont Province, and are associated with plutonic intrusions of gabbro, granite, and ultra-basic rocks. The pegmatites are the final acid differentiates of this series. There is considerable evidence to show that all these rocks were intruded during one magmatic cycle, and were accompanied by extensive regional metamorphism.

Differentiation in the pegmatites can be traced through the following sequence: granite, pegmatitic granite, microcline pegmatite, plagioclase pegmatite, quartz veins. Explosive release, due to a concentration of volatile constituents, is probably one cause of dike formation.

The majority of Maryland pegmatites are high-pressure injections of magma. They show little contact action, even in dolomite; they have the structure of dikes, and have deformed their wall rocks. The hydrothermal facies of these pegmatites include: feldspathization, tourmalinization, pyritization, and epidotization. The Setters formation (pre-Cambrian) around Baltimore has been impregnated with tourmaline for a distance of 20 miles. Tourmaline-pegmatite and tourmaline-quartz veins are probably responsible for this. A few pegmatites are probably entirely of hydrothermal origin.

The replacement of minerals of early formation in pegmatities by others of later formation is abundant in Maryland. The relations are generally simple and the sequence is: microcline, muscovite, plagioclase, quartz, sulphides. The greatest amount of replacement has been of microcline by plagioclase and quartz. This replacement is thought to be a continuous and uninterrupted process, brought about by reactions within the pegmatite, the conditions changing from those typical for a magma to those typically hydrothermal. In many case it is thought that all the minerals now present in the dikes were introduced at the time of the original injection. Thus, at Ilchester, there is a large mass composed of nearly equal amounts of albite, microcline, and quartz

which formed simultaneously. Further differentiation during the injection of the pegmatite produced bodies enriched in plagioclase and quartz. (*Author's abstract.*)

Discussed by Mr. SCHALLER.

JOSEPH T. SINGEWALD, JR., and CHARLES MILTON: *Greisen and associated mineralization at Silver Mine, Missouri.* Silver mine lies nine miles west of Fredericktown, Missouri, on the west side of the St. Francis River. At the river level is the old Einstein silver mine opened on argentiferous sulphide ore a half century ago. A quarter mile back from the river is the Apex mine which was reopened during the World War as a producer of tungsten ore. A mile and a quarter from the river the Ozark Tungsten Company was developing a tungsten ore body in 1927.

Granite country rock has been changed to a topaz greisen along the walls of the ore body. The greisen consists of varying proportions of quartz, sericite, and topaz. Subsequent to griesenization fluorite, wolframite, and the common sulphides were introduced into the wallrock by replacement. These minerals occur disseminated in minute spots, streaks, and veinlets. At the Apex and Einstein mines the wallrock is locally altered to lithium-bearing mica and damourite.

The wolframite in the ore at the Ozark mine ranges in composition from the high manganese to high iron end of the series, frequently with regular crystallographic intergrowths of opaque black mineral and translucent red mineral. It occurs as the matrix of a greisen breccia. It has been extensively altered to a gossan of limonite and goethite containing minute aggregates of ferritungstite and stolzite.

At the Einstein mine sulphides occurred in greater abundance and the ore is argentiferous. A sulphide concentrate consisting mainly of sphalerite and pyrite and containing 22 per cent galena assayed 15 ounces of silver, but no silver minerals were recognized on polished surfaces of the ore. The sphalerite is characterized by an abundance of chalcopyrite inclusions which probably represent unmixing of a solid solution for the most part. The lithium-bearing mica has the optical properties of zinnwaldite but an analysis showed only 0.58 per cent lithium. Cassiterite was found for the first time at this locality and is closely associated with fluorite and zinnwaldite.

The mineralization is related to the typical tin vein type. Tourmaline is the only common member of that type which has not yet been found. The paragenetic sequence begins with a transformation of the minerals of the granite into quartz, sericite and topaz. Then followed arsenopyrite and pyrite, cassiterite, and zinnwaldite. Fluorite began to form while cassiterite was still being deposited and extended into the period of deposition of wolframite, sphalerite, and chalcopyrite which were almost contemporaneous. Galena was the last of the ore minerals deposited. Damourite was a late hydrothermal mineral. Supergene minerals are limonite, goethite, ferritungstite, and stolzite. (*Author's abstract.*)

Discussed by Messrs. C. S. ROSS and FERGUSON.

453D MEETING

The 453d meeting was held at the Cosmos Club April 24, 1929, President CAPPS presiding.

Program: Dr. J. J. SEDERHOLM, Director of the Geological Survey of Finland: *The Origin of granite injected rocks* (*Migmatites*).

Discussed by Messrs. KEITH and LARSEN.

454TH MEETING

The 454th meeting, was held at the Cosmos Club May 8, 1929, President CAPPS presiding.

Informal communications: L. W. STEPHENSON called attention to the preservation of color markings in specimens of *Exogyra* from the Austin chalk of Texas. A new species of *Ostrea* was also found in a restricted zone one foot thick about ten feet above the *Exogyra* zone. Discussed by Mr. GOLDMAN.

Program: G. R. MANSFIELD: *Structure of the Blackfoot Moutains, Idaho.* The Blackfoot Mountains which lie a few miles southeast of Idaho Falls, Idaho, extend southeastward about 30 miles and occupy an area 6 miles to 15 miles wide. They are broader toward the northwest and Mt. Taylor (Blackfoot Peak), 7,414 feet in altitude, is the highest summit. Most of these mountains are included in the Ammon and Paradise Valley quadrangles.

The older strata, which range in age from Upper Mississippian to Lower Cretaceous, are overlapped in considerable measure by Tertiary sediments and lavas. The mountains are traversed by many folds, large and small, which are broken by thrust and normal faults. The Snowdrift anticline, one of the principal folds, continues 50 miles or more to the southeast. In the southern part of the Blackfoot Mountains (Paradise Valley quadrangle) this fold bears on its west flank a window in the Bannock overthrust, which lies nearly 10 miles back from the front edge of the fault block, as exposed in the Cranes Flat quadrangle to the northeast. Another window in the overthrust occurs in the Chesterfield Range to the southwest (Portneuf quadrangle) and lies 20 miles back from the front. Northwestward in the Ammon quadrangle the Bannock overthrust deploys into three major and many minor branches. In structure sections the folded and faulted rocks are represented as piled up in slices, which rest on a principal fault plane or "sole" in a manner similar to that obtained in Cadell's experiments illustrative of structure in the Scottish Highlands. Horst and graben structures are superimposed on these earlier folds and faults. There are also transverse faults and it is thought that one of these in the Paradise Valley quadrangle may be a tear fault or flow. Possible extensions of the Bannock overthrust and the relations of this fault to overthrusting in the northern Rocky Mountains were briefly discussed Older objections to the contraction hypothesis no longer hold in the light of newer conceptions of the age of the earth and of the behavior of radio-active materials in the earth's crust. Reduction in the earth's volume by gravity and other causes is therefore regarded as the most probable source of the great horizontal stresses which have produced the overthrusts. (*Author's abstract.*)

Discussed by Messrs BUTTS, BAKER, BRADLEY.

L. W. STEPHENSON: *Unconformities in the Upper Cretaceous of Texas.* Discussed by Mr. GOLDMAN.

C. P. ROSS: *History of mining in Idaho.* The mining history of Idaho may be reviewed by means of three charts which summarize the statistics in graphical form. These show that there was considerable placer mining in the sixties, a depression in all mining in the seventies and that lode mining started in the eighties and that the mining of lead-silver ore soon became the dominant factor in the industry. Improvement in metallurgy has recently caused some increase in the production of zinc. The production of copper, never large, reached its peak in 1907 and has since been declining.

Shoshone County has been the outstanding producer almost since the first

discovery in it of the deposits of the Cour d'Alene district and in 1926 produced nearly 94 per cent of the total for the State. Boise and Idaho counties were the dominant producers in the early placer days but have since been relatively unimportant. Blaine, Custer and Lemhi counties had large productions in the eighties and each has had a revival since 1900. Custer County, the least important of the three in the early days, has had the most encouraging revival, while the formerly famous Blaine County had the smallest and most delayed revival of the three. Owyhee County had an early placer boom, followed by active production from lodes in 1867 to 1876 and again in 1889 to 1914, the longest period of mining prosperity anywhere in Idaho outside of Shoshone County.

Production in each of the counties, except Shoshone County, has been governed primarily by discovery of ore and only secondarily by economic factors, and in most the quantity found in any one period was small. Although ores of numerous metals exist, production of lead-silver ore is the only branch of the industry of importance now or likely to become so in the near future. (*Author's abstract.*)

Discussed by Messrs FERGUSON and HEWETT.

A. A. BAKER, JAMES GILLULY, *Secretaries*

SCIENTIFIC NOTES AND NEWS

Dr. PAUL BARTSCH, Curator of Molluscs in the U. S. National Museum, is spending the summer in the lesser Antilles in connection with his second year's work under the grant of the Walter Rathbone Bacon Traveling Scholarship.

Dr. J. W. GIDLEY, of the U. S. National Museum, is visiting localities in Idaho, Montana, Oregon, and Washington to investigate reported finds of fossil vertebrates. He will later visit western museums to examine paleontologic collections.

Dr. C. E. RESSER, of the U. S. National Museum, is continuing his studies of the Cambrian stratigraphy of the Rocky Mountain region, devoting this summer particularly to formations in Idaho and Montana.

Dr. H. S. LADD, of the University of Virginia, is spending several weeks at the National Museum, completing a report on the geology and paleontology of Vitilevu Island, one of the Fiji group. Dr. J. E. HOFFMEISTER, of the University of Rochester, is engaged in a study of corals collected last summer in the Tonga Islands. It is expected that they will aid in determining the geologic history of the islands. Dr. A. F. FOERSTE, of Dayton, Ohio, is continuing his studies of Paleozoic cephalopods, particularly those of Canadian and Ozarkian age, which he and Dr. E. O. ULRICH are describing in monograph form. Messrs. R. W. HARRIS and C. T. MATTHEWS have spent some weeks at the National Museum examining recent and fossil Bryozoa and Ostracoda.

Dr. ALEŠ HRDLIČKA, with Dr. MALY, of Prague, as assistant, is in Alaska in connection with his studies of the American Indian.

Dr. REMINGTON KELLOGG, of the U. S. National Museum, is visiting various museums and private collections, particularly in California, to study the history of the fossil whales. The project is a cooperative undertaking of The Carnegie Institution and the National Museum.

The zoological collection of the late Colonel Wirt Robinson, containing 500 specimens of large and small mammals from the eastern United States, an assemblage of large birds, and a collection of insects has been received by the National Museum. Colonel Robinson had presented a large part of his collection of birds to the Museum before his death. The Museum has also received a splendid collection of land, fresh-water and marine shells made by Mr. John K. Townsend in the early part of the last century.

The following men have been recently appointed in the U. S. Geological Survey: ROLAND W. BROWN, paleobotanist to succeed F. H. Knowlton, deceased. ARMAND J. EARDLEY, DAVID A. ANDREWS, WILLIAM G. PIERCE, ALONZO W. QUINN, THOMAS A. HENDRICKS, HAROLD E. THOMAS, and FRANK S. PARKER, junior geologists in the Section of Geology of Fuels; MARLAND P. BILLINGS, assistant geologist in the same section. HOWARD A. POWERS, junior geologist in the Section of Volcanology. EUGENE CALLAGHAN and IAN CAMPBELL, junior geologists in the Section of Metalliferous Deposits, and QUENTIN D. SINGEWALD, assistant geologist in the same section.

Dr. A. S. HITCHCOCK, U. S. Department of Agriculture, left New York, June 8, for London on his way to South Africa. He will attend, by invitation, the South African Association for the Advancement of Science at Cape Town and Pretoria and will give a paper on the *Relation of grasses to man.* The British Association for the Advancement of Science meets this year in South Africa jointly with the South African Association. Dr. Hitchcock will visit Victoria Falls and then, by way of Beira, Portuguese East Africa, will go to Tanganyika and Kenya where he will spend about a month collecting grasses on the table land about Nairobi. He hopes to obtain temperate and alpine species on Mt. Kilimanjaro. The return to London will be through the Red Sea with brief stops in Egypt and Palestine.

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WASHINGTON ACADEMY OF SCIENCES

VOL. 19 AUGUST 19, 1929 No. 14

PHYSICS.—*Internal pressures in adsorbed films.*[1] P. G. NUTTING, U. S. Geological Survey.

When a vapor or gas is dissolved or adsorbed, there is a perfectly definite relation between concentration or thickness of adsorbed film and external pressure and temperature. Such weight-pressure and weight-temperature curves are readily obtained experimentally, but little progress has been made in their analysis and interpretation. The general problem is of wide interest and importance, for a variety of problems in molecular physics and physical chemistry are but special cases of the general problem, and its solution means the solution of a host of lesser problems. The writer has determined a great number of weight-humidity and weight-temperature curves for the hydrous oxides and silicates and his interest lies in obtaining from these data energies of association and relations between internal and external pressures.

GENERAL PRINCIPLES

When the temperature is uniform throughout any system, the free energy per mole (or per molecule) must also be constant throughout the system, otherwise there would be a net flow of heat from one point to another and this would require a temperature difference. In technical language the thermodynamic potential is everywhere the same. Energy per unit mass times concentration is energy density or energy per unit volume.

When mechanical equilibrium exists throughout any system, the sum of all the pressures normal to any plane is zero. Otherwise there

[1] Received May 14, 1929. Published by permission of the Director of the U. S. Geological Survey.

would be a net drift of material in one direction. In a gas or vapor there are two equal and opposite pressures, the *confining pressure* p inward and the *kinetic pressure* κ outward. In a liquid or solid there are in addition two other pressures, usually very much greater than the two just mentioned, the *cohesion pressure* P and the *contact pressure* π, intensively investigated in recent years by the late T. W. Richards.[2] At equilibrium $p + P = \pi + \kappa$ at every point and in every direction. Besides these four principal pressures others come into play in certain special cases such as solutions. Richards deduced cohesive pressures from compressibilities (β) and thermal expansions (α) using the relation $P = T\alpha/\beta$. I wish to point out some more general and more generally useful methods of arriving at these various pressures.

Since the kinetic pressure is equal to the free (thermal and mechanical) energy density times concentration c, the free energy per mole (RT) is everywhere the same and therefore $\kappa = CJRT/M$ in dynes/cm². In other words the kinetic pressure is simply the external or confining pressure corrected for concentration, $\kappa = cp/c_o$ when c_o is the concentration of the vapor phase.

The cohesive pressure is equal to the concentration times the free energy per gram necessary to bring the material to the state or phase in question (latent heat, work of compression, condensation, etc.) from a state (vapor) where it is zero. Therefore, in a liquid,

$$\frac{P}{\kappa} = \frac{q}{RT} = \frac{d \log C_s}{d \log T} \tag{1}$$

a very useful relation since kinetic pressure is so readily determined. If the work done by the cohesive pressure were all done against the kinetic pressure, dP would be equal to $C\,\kappa\,dv = -\kappa\, d \log C$ and therefore $P/\kappa = \log c/c_s = q/RT$, would be a simple relation between change of concentration (from saturated vapor C_s to liquid C) and latent heat (q calories per mole) but the value so computed for water at 26° is only about 0.6 the actual value indicating that 0.4 of the work is done against the distending pressure π.

Equation (1) applies to any liquid in its natural state. If however, heavy external pressures or internal adsorption pressures be applied, the work of compression, the integral of $p\beta dp$ must be added to the latent heat in finding cohesive pressure. In the more general case of

[2] Jour. Am. Chem. Soc. **48**: 3063–80. 1926. Chem. Rev. **2**: 315. 1925. And previous papers.

added pressures capable of doing work, (1) takes the more general form

$$(1a) \qquad \frac{P}{\kappa} = \frac{q}{RT} + \frac{e}{RT} = \frac{d \log C_s}{d \log T} + \int_0^p \frac{d \log C}{d \log p}\, dp$$

where c is the concentration of the liquid affected by the extra pressure p: Similar reasoning applies to solids and the change from liquid to solid. If latent heats (L) are given, the most convenient formula is $P_2 = C_2L_{12} + C_1L_{01}$, the subscript 2 referring to the solid and 1 to the liquid state.

These very simple relations between concentration, temperature and the internal kinetic and cohesive pressures cover all ordinary problems in change of phase, obviating the use of an equation of state which after all represents but an illogical attempt to relate the properties of a substance to the external confining pressure. At a free liquid-vapor surface, the surface tension must just equal the kinetic pressure per molecular layer (dynes per cm.). Surface tension may be readily calculated from vapor pressure in this way. Surface energy, $\sigma - Td\sigma/dT$, is easily derived from surface tension σ when its temperature coefficient is known. Osmotic pressure is the increase in cohesive pressure due to dissolved salt hence is $\kappa \log C_s/C$ since it causes a lowering of vapor concentration from saturation C_s to C. At the critical state P and π become zero, $\kappa = p$ and the surface tension drops to zero since the concentration is uniform. Many other simple applications might be cited.

Some numerical data will serve for illustration. For water at 26°C. $p = 33590$ dynes/cm², $v = 40950$ cc/gram. The kinetic pressure $\kappa = 1379$ megadynes/cm² (from RT), 1375 md/cm² (from p/c) and 1376 (from the external latent heat). The cohesive pressure $P = 24340$ md/cm² (from the latent heat) or 24360 md/cm² from $P = d \log C_s/d \log T$. By difference, the contact pressure (outward), $\pi = 22970$ md/cm². The vapor pressure is quite negligible in comparison with the internal pressures but when large external pressures are applied to a liquid or solid they must be reckoned with the cohesive pressure in computing work done.[3]

Taking for the kinetic pressure of liquid water ($C = 1$), 1380 megadynes/cm² and multiplying by the molecular diameter 5.2×10^{-8} cm gives for the surface tension 72 dynes/cm. A sulphuric acid-

[3] *Cf.* "Deformation and Temperature," this JOURNAL, March 19, 1929.

water solution 56.1 per cent water (by weight) has a vapor pressure half that of free water hence the cohesive pressure of the water is increased by the H_2SO_4 by log 2 = 0.69 of the kinetic pressure κ, or by 1050 md/cm² which is about 4 per cent of the cohesive pressure of pure water. The osmotic pressure (1050 md/cm²) divided by the concentration of H_2SO_4 (gm/cc) gives the energy of the dissolved acid in ergs/gram, the fundamental variable. In the case just mentioned the acid in solution has about four times as much energy per gram as has the straight acid. In this case, as well as in adsorption, the cohesive pressure represented by $\kappa \log C/C_o$ is an external negative pressure so far as the vapor is concerned hence it operates (on one or more walls) to diminish the confining pressure p.

ADSORPTION AND HUMIDITY

An adsorbed film on a solid is in equilibrium with vapor of concentration C less than saturation C_s. Then $RT \log (C_s/C)$ is the additional external work (in calories/mole) of condensation due to the presence of the solid. This work is due to an increase in cohesive pressure within the film of $\Delta P = \kappa \log (C_s/C)$ where $\kappa = CJRT/M$, C being the concentration of liquid at the outer surface of the film. As the adsorbed film increases in depth, the cohesive pressure decreases rapidly at first then more gradually to that in the pure liquid.

In the case of silica and water the inner layers of adsorbed water are so compressed that the concentration is about 1.3 which corresponds with an additional cohesive pressure of about 17000 atmospheres (1.3 × 1380 megadynes/cm²). This is the equivalent of the "heat of wetting" for an immersed solid[4] and corresponds to a humidity below that given by P_2O_5. Solids which retain water at extremely low humidities may exhibit very high cohesive pressures and at the limit (single layer of molecules), exert chemical forces of actual combination. At the other extreme are salts such as KCl which adsorbs no water until the humidity is above 80 per cent but then adsorbs freely. In this case the maximum cohesive force between salt and water is less than one-fifth (log 1/.80) that normal to pure water. Such a salt will not cake as long as the humidity is held below 80 per cent.

The theory of adsorption of gases does not differ from that given above for vapors but the constants for liquified gases are less well known. However it is more logical, near and above the critical tem-

[4] NUTTING, Jour. Phys. Chem., **31**: 531–4. 1927.

perature, to integrate the work done against kinetic pressure. This integration gives for the cohesive pressure due to adsorption $\Delta P = \kappa \log(\kappa/p)$ where p is the gas pressure and $\kappa = CJRT/M$ is the kinetic pressure in the adsorbed film of concentration c gms/cc. Freundlich's equation (quantity adsorbed proportional to a power of the pressure of adsorbed gas or vapor) is consistent with the theory here given as are many other such possible relations, but the falling off of cohesive pressure with depth is only roughly approximated by a logarithmic function.[4] This curve has a rather sharp bend in it and can not be accurately represented by any simple function.

The energy of adsorption in an adsorbed film is readily obtained from experimental data (on weight-humidity). It is the integral of $\Delta P/C$, cohesive pressure due to adsorption over concentration, or

$$E_1 = RT \int_0^z \log (C_s/C)dZ \tag{2}$$

from the solid surface out to a depth Z, in calories/mole/cm.[2]

ADSORPTION AND TEMPERATURE

The effect of a rise in temperature on adsorption is due to several contributing factors; a (slight) decrease in concentration of adsorbed material and a slight decrease in adsorptive forces but chiefly on the first order increase in kinetic pressure and on the large increase of saturation pressure with temperature. Since the cohesive pressure due to adsorption is $P_a = \kappa_a \log(\kappa/p)$, the change $dP_a/dT = dP_a/d\kappa \times d\kappa/dT$ (external vapor pressure p not varying) $= dP_a/dZ \times dZ/dT$ where Z is the film thickness. Carrying out the operations indicated, $dZ/d \log T = dZ/d \log P_a$ or the depth varies with temperature according to the same law as it does with cohesive pressure due to adsorption.

The cohesive pressure at the freezing point and the kinetic pressure at the critical temperature are evidently natural constants of considerable importance for each substance but their discussion is hardly relevant to the subject of this paper.

SUMMARY

Simple thermodynamic definitions of kinetic and cohesive pressures are given, applicable to any homogeneous system in equilibrium.

The simple relations between internal pressures and concentration are pointed out in contrast to equations of state.

The principles developed were applied to the calculation of surface tension directly from vapor pressure.

Cohesive pressures in adsorbed films are shown to be derivable from vapor pressure and from temperature data.

The essential relation between excess cohesive pressure and osmotic pressure was pointed out.

In a later paper the principles here developed will be applied to some weight-temperature and weight-humidity data.

PALEONTOLOGY.—*A fossil ant from the Lower Eocene (Wilcox) of Tennessee.*[1] F. M. CARPENTER. (Communicated by E. W. BERRY.)

Professor E. W. Berry, of the Johns Hopkins University, recently sent me for identification a large ant wing from the Wilcox clays of Tennessee.[2] Since venation is of little value in the taxonomy of the Formicidae, it is quite impossible to determine the exact affinities of this new species. The presence of a discoidal and two cubital cells eliminates it from the Formicidae, to which one might at first be tempted to assign such a large species, and there are, moreover, several structural characteristics so strongly suggestive of the Ponerines that I do not hesitate to place it within this subfamily. The generic affinities, of course, are more obscure. The position of the transverse vein (Tr) at the base of the discoidal cell is similar to that in some genera of Ponerines, mostly within the tribe Ponerini. The first and second cubital cells are much smaller than in any other known ant wing, and the apical side of the first cubital cell is unusually remote from the corresponding side of the second cubital, of which it is generally a continuation. The nearest approach to these conditions is found in the Neotropical *Dinoponera,* and I am inclined to believe that this wing belonged to a species more or less closely related to *Dinoponera.*[3] Such a relationship seems even more probable when we consider that a similar Ponerine genus, closely allied to *Dinoponera* and the South African *Streblognathus,* existed in the Miocene of Florissant, Colorado.[4]

[1] Received May 31, 1929.

[2] Only a few insects, Coleoptra, Trichoptera, and Isoptera, have been described from this formation.

[3] Professor W. M. Wheeler has kindly permitted me to compare this fossil with the ants in his collection, and he also assisted me in making these comparisons.

[4] This Florissant genus is described in my monograph of the fossil ants of North America, now in press (Bulletin Mus. Comp. Zool.).

Eoponera, new genus

Very large ants allied to *Dinoponera*. Fore wing with a small first cubital cell, the apical side joined to the basal part of the stigma; second cubital cell also very short; transverse vein leading to the anal from the base of the discoidal cell.

Genotype: *Eoponera berryi*, new species.

Eoponera berryi, new species

Fig. 1

Represented by the obverse and reverse of a fore wing, 26 mm. long, and 7 mm. wide. The stigma is long and narrow; the discoidal cell is triangular. The apex of the wing is missing, but from the rest of the fossil one would assume that the shape of the complete wing would be much like that of *Myrmecia*.

Holotype: Cat. no. 80825, U. S. N. M. Collected at Puryear, Henry County, Tennessee.

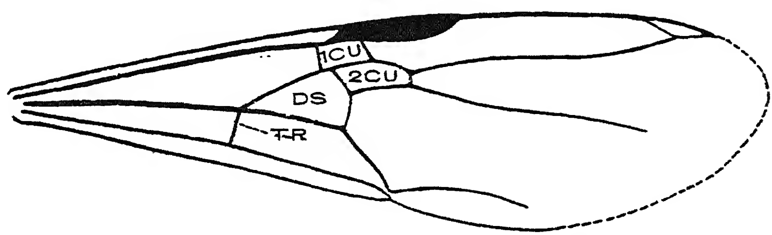

Fig. 1.—Forewing of *Eoponera berryi*, n. sp., from the lower Eocene clays of Tennessee. *1 Cu* and *2 Cu*, first and second cubital cells; *Ds*, discoidal cell; *Tr*, transverse vein.

Although the generic affinities of this species are obscure, it is one of the most interesting fossil ants that has been found. Its great size shows that the complete insect must have had an expanse of at least two and a quarter inches, or 57 mm.! The only known recent ant of such dimensions is *Camponotus* (*Dinomyrmex*) *gigas* (Latr.), of Sumatra and the Malay Peninsula. *Dinoponera grandis* (Guérin) is the largest Ponerine, and although no winged female of this ant seems to exist at present, it is very probable that its queen would be about the same size as that of *E. berryi*. A still more interesting aspect of this new ant is its geological position. Until now the oldest record of the ants has been in the Green River Shale of Utah, Wyoming and Colorado, which is of Middle Eocene age (Auversian). Professor Berry's comprehensive study on the flora of the Wilcox formation has shown that these beds are of Lower Eocene age (Sparnacian-Ypresian), so that this new fossil is the earliest ant that has been found. Strangely enough, the Green River ant-fauna, although not well known seems to be about as highly developed as that existing to-day, and we can only hope that further specimens from the Wilcox beds will be complete enough to throw some light on the origin of the Formicidae.

BOTANY.—*A plea for the conservation of* Muhlenbeckia.[1] J. FRANCIS MACBRIDE, Field Museum of Natural History. (Communicated by PAUL C. STANDLEY.)

In a recent issue of this journal[2] I suggested that obedience to the fundamental provisions of the International Botanical Rules is necessary, if in fact they constitute a document of importance, to be taken seriously. Of course it may be expected that one with any sense of humor or imagination will condone an interpretation of a minor rule to suit the exigency of a given case as the author may feel reason or expediency demands. But surely the Rules, if they have the import of law, must be adhered to literally, in basic principle. For this reason, as already pointed out, the name *Calacinum* Raf. must supplant *Muhlenbeckia* Meissn. unless, by a duly constituted Congress or its Committee, the latter is conserved.

Now it happens that there are two species of *Muhlenbeckia* not yet treated under the name *Calacinum* which in the course of my work I am called upon to dispose of. To list them under the former when well-aware of the validity of the latter would be a tyrannical action, certain to be regarded as disrespectiful to fellow-workers under the Rules. But surely to refrain from publication under either name until a Congress can decide whether to let the law take its course would be honorable and not illegal. Naturally the latter alternative is chosen, since it is now my personal conviction that *Muhlenbeckia* should be conserved. (Though, as a matter of legal routine, I, myself, once restored *Calacinum.*)

It is conceivable that under some circumstances postponement of publication would be inconvenient or impractical, but this can scarcely be the case when a Congress is meeting within a year or two. As a matter of course, if deferment is impossible *Calacinum* would be used by the law-abiding student, even if ultimate conservation of *Muhlenbeckia* should be sought. (I assume that no personal interest in "authorities" would enter into a matter so purely scientific.)

The argument for the conservation of *Muhlenbeckia* can be summed up in a very few words. As no possible interpretation of the Rules can give it legal standing let it be conserved frankly for reasons of sentiment and practicability: because it is well-known in horticulture and because it commemorates the work of a botanist to whom the honor

[1] Received June 10, 1929.

[2] THIS JOURNAL 19: 247. June 19, 1929.

is due. Indiscriminate conservation on such grounds as these is generally to be deplored but surely it would be a desirable and reasonable action in the case of this small genus.

BOTANY.—*Three new grasses from French Sudan.*[1] A. S. HITCHCOCK, Bureau of Plant Industry.

In a collection of grasses from French Sudan submitted for identification by the collector, Dr. O. Hagerup, of the Copenhagen Botanical Museum, the following species appear to be undescribed.

Brachiaria hagerupii Hitchc., sp. nov.

Laminis planis, pubescentibus, 8–15 cm. longis, 8–10 mm. latis; paniculis, angustis, 10–15 cm. longis; ramis appressis, rachi pubescente et hispido; spiculis ellipticis, glabris, 3.5 mm. longis; gluma prima 2 mm. longa.

Sheaths glabrous; blades flat, finely pubescent, 8 to 15 cm. long, 8 to 10 mm. wide; panicles narrow, 10 to 15 cm. long, the axis angled, pubescent, the racemes appressed, somewhat overlapping, 2 to 3 cm. long, the rachis pubescent like the axis, also with scattered stiff white hairs; spikelets mostly in pairs, unequally short-pediceled, glabrous, elliptic, scarcely turgid, narrowed at base, somewhat acuminate, the nerves anastomosing toward the tip; fertile lemma slightly apiculate, rather sharply cross-wrinkled, the pedicels with stiff hairs; first glume about half as long as the spikelet.

Type in the U. S. National Herbarium, no. 1385813, collected at Timbuktu, French Sudan, Africa, August 17, 1927, by O. Hagerup (no. 271).

The specimen shows only the upper part of two culms.

Eragrostis pallescens Hitchc., sp. nov.

Perennis; culmis 60 cm. altis, glabris; vaginis glabris, ore dense piloso; laminis angustis, involutis, glabris, 7–15 cm. longis, longe acuminatis; paniculis pallescentibus, angustis, 15–20 cm. longis, rachi ramisque etiam in axillis glabris; ramis circ. 4 cm. longis; spiculis 5–13 mm. longis, 0.5 mm. latis, 10–30-fl., floribus imbricatis; lemmatibus 1.5 mm. longis, glabris; paleis persistentibus.

Perennial; culms erect from a spreading base, glabrous, about 60 cm. tall; sheaths glabrous, densely pilose at the mouth; blades narrow, involute, glabrous, 7 to 15 cm. long, gradually acuminate to a fine point; panicle narrow, pale, 15 to 20 cm. long, the axis and axils glabrous; branches ascending, about 4 cm. long, the rachis glabrous; spikelets somewhat compressed, closely set, appressed, 5 to 13 mm. long, 0.5 mm. wide, 10 to 30-flowered; lemmas 1.5 mm. long, scaberulous on the keel, imbricate; palea persistent.

Type in the U. S. National Herbarium, no. 1385811, collected at Timbuktu, French Sudan, June 6, 1927, by O. Hagerup (no. 105).

[1] Received June 14, 1929.

Eragrostis albida Hitchc., sp. nov.

Annua; culmis patulis, gracilibus, 15–20 cm. altis; vaginis glabris, ore piloso; laminis angustis, involutis, 1–3 cm. longis; paniculis albescentibus, patulis, oblongis, in axillis glabris, 5–7 cm. longis; ramis 1–3 cm. longis; spiculis appressis, 4–9 mm. longis, 6–15-fl.; lemmatibus 1.5 mm. longis, acutis; paleis persistentibus.

Annual; culms slender, spreading at base, 15 to 20 cm. tall; sheaths glabrous, pilose at the mouth; blades spreading, very narrow, involute, 1 to 3 cm. long; panicle oblong, open, 5 to 7 cm. long, whitish, glabrous in the axils, the branches spreading or ascending, slender, naked below, 1 to 3 cm. long; spikelets appressed and imbricate, 4 to 9 mm. long, somewhat compressed, 6 to 15-flowered; lemmas 1.5 mm. long, narrowed above and acute; palea persistent.

Type specimen in the U. S. National Herbarium, no. 1385812, collected at Timbuktu, French Sudan, June 22, 1927, by O. Hagerup (no. 107).

ETHNOLOGY.—*A point of resemblance between the ball game of the Southeastern Indians and the ball games of Mexico and Central America.*[1] JOHN R. SWANTON, Bureau of American Ethnology.

My studies of the ball game of our Southeastern Indians have brought out a peculiar feature which seems to have had its counterpart in the ball games of the Nahuatl and Maya farther south. There are considerable differences between the game (or games) as played in these two areas, since among the Mexicans and Central Americans ball-courts of stone were especially constructed for it, very few players participated, and no rackets were used, the ball being propelled by striking it with various parts of the body, usually the hips. Indeed, speaking of the Nahuatl game, Zorita says players were compelled to use the hips and if any other part of the body touched the ball the opponents scored a point. The southern game also differed in providing an opportunity to win by a single shot through a hole in a stone midway of the wall. One of these stones was, of course, placed on each side. But this shot was such a difficult one that, although he who made it won, it was unlucky, since it was not attributed to his skill but to some evil or uncanny quality attaching to him. Zorita says that he was regarded as a thief or an adulterer, or one destined to an early death. Therefore, it is evident that games ordinarily turned upon points obtained in the other ways mentioned.

When I came to study the Creek ball game, it struck me as a curious fact that, while the goals were much like our own in lacrosse, to

[1] Received May 15, 1929.

strike one of posts counted as a goal equally with a drive between them. For some unexplained reason the old Choctaw goals were like those of the modern Creeks, whereas the ancient Creek goals and the modern Choctaw goals differ. The latter consist of two planks, four to six inches wide, placed side by side and with no space between. A goal is made by striking the post but the ball must also come to the ground inside of a foul line running through the goal post. The two planks may be the side posts of the goal now brought close together. Before crossbars were used, the Choctaw goal seems to have been formed of two poles set in the ground some distance apart but brought together at the top. The old Creek goal is described as just the reverse of this, made of two poles or withes which diverged at the upper ends, points being scored either by striking the poles or driving the ball over them.

Finally, Du Pratz tells us that the goal of the Natchez game, played annually at the time of the harvest—or rather the new corn—ceremony, were the cabins of the Great Sun and the Head War Chief, and that the game was ended when the ball struck one or the other.

Mention should also be made of the method of scoring in the single pole game, played quite generally throughout the Gulf area. Among the Creeks, men and women usually opposed each other in this game, women driving the ball with their hands while the the men were permitted to use only their sticks. Points were made by striking the pole above a certain mark, and at the very top was a cow skull, a horse skull, or some object made of wood, to hit which scored more than if the pole itself were touched.

On examining methods of making goals among North American tribes having either the single stick game or the two stick game, we find that there are three: (1) hitting a post, reported by three informants out of four from the Chippewa, by one from the Missisauga, one from the Miami, one from the Creeks (Bartram), which is also the present usage of the Choctaw; (2) carrying the ball past a line marked by one post or a line of posts, reported from the Cherokee by one early informant, from the Caughnawaga (probably erroneously), once from the Huron, once from the Dakota, from the Chinook, Pomo, and Miwok; and (3) driving or carrying the ball through a gate, recorded among the Chippewa, among the Thompson Indians, the Dakota, the Iowa, once among the Huron, and among the Mohawk, Seneca, Creeks, and modern Cherokee, and among the Choctaw of an earlier period.

The two last methods appear to be associated more often than is

either with the first. There is a slight suggestion that the first may have had properly a distribution down the Mississippi and this again may have had something to do with the custom spread throughout that area of "striking the post" when announcing successes in war. At any rate two ideas appear to be involved, one scoring by driving the ball past some mark or marks or through some opening, the other scoring by hitting a post or wall, and it is probably significant that, while the goals of the Iroquois, the old time Choctaw, and the modern Creeks were of the two-post type, striking the posts did not count among the Iroquois unless the ball went completely through but it did count with the two Muskhogean tribes. This fact, taken in conjunction with the Natchez usage, leads me to suppose that the goal posts were conceived of in the Southeast as outlining a solid surface. It is in this fact that the resemblance to Mexican systems of scoring appears. The old Creek usage of counting a drive over the posts may be compared with the Mexican usage of counting a drive over the wall.

One difficulty in comparing the ball games of the two areas is presented by the fact that rackets appear to have been unknown to the Mexicans and Middle Americans. However, Bernard Romans informs us that, besides the game with rackets, the Choctaw had a similar game played with a larger ball in which only the hands were employed, and Bushnell shows that this lasted until quite recent times among the Choctaw of Bayou Lacombe, Louisiana, where it was not given up until after the game with ball sticks had been abandoned. The Natchez game also seems to have been played without rackets, and it is possible that they represent an invention of some tribe farther north and east.

Conclusions.—It is believed by most ethnologists who have had occasion to compare the culture of our southeastern Indians with the cultures of the tribes of Mexico and Middle and South America that certain similarities which they present may best be explained by borrowing. Among these may be mentioned head deformation, the use of the blowgun, blackening of the teeth, and probably mounds as the foundation of sacred edifices. There seems to me to be little doubt that the method of scoring points in the ball game, so different from that in vogue among the Iroquoian peoples and among ourselves, is another example of the same thing.

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PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

PHILOSOPHICAL SOCIETY

989TH MEETING

The 989th meeting was held in the Cosmos Club Auditorium, March 30, 1929.

Program: WARREN W. NICHOLAS, *Structure of the electron.*—It is recalled that the well-known electromagnetic "pulse" theory of X-rays (Stokes, 1897) is in many ways immensely satisfactory when applied to phenomena observed with X-ray continuous spectra. This pulse theory fails, however, to account for the observed spectral energy distribution, the most apparent difficulty being that of accounting for the high frequency limit of the continuous spectrum. Simple experiments are performed with a pendulum (illustrating an oscillator within an atom) which show the manner in which the pulse must affect some atomic oscillators of extremely high frequency; this proves that the pulse would not have a definite high frequency limit, and therefore that the simple pulse theory must be discarded.

It is then shown how this difficulty could be avoided (still retaining all the satisfactory features of the pulse theory) by assuming a more complicated form of pulse; this pulse would be produced by an electron consisting of both positive and negative charge, this charge being distributed over an infinite length along its line of motion according to the formula $\frac{\sin x}{x}$. This would provide for a net negative charge of e as generally accepted, and this electron would account for all the very complicated phenomena so far observed with X-ray continuous spectra.

An extension of the ideas is obtained by supposing that the electron is not of infinite, but of finite, length, of the order of 10^{-7} cm. This finite electron would then not only account for X-ray continuous spectra, but would provide a source for the penetrating cosmic radiation.

It is pointed out that, while the main physical ideas about this electron may be very clear, it is possible that the quantitative relationships may not be expressible in terms of simple mathematical formulae. (*Author's Abstract.*)

W. F. MEGGERS and R. M. LANGER. *Light scattering in liquids.*—In February, 1928, Professor Raman of Calcutta announced the discovery that when monochromatic light is scattered in a transparent pure liquid, the diffused radiation ceases to be monochromatic, in addition to the incident radiation scattered with unmodified wavelength, fainter lines or bands with modified wavelengths appear in the spectrum of the diffused radiation. This new type of radiation immediately attracted much attention and efforts to confirm and extend the observations have been made in a great many laboratories all over the world. The usual experimental arrangement is that first described by Raman and Krishman; it consists of a spherical bulb, filled with liquid, at the center of which the light from a mercury arc is focussed with a condensing lens. The scattered radiation is photographed with small scale prismatic spectrographs with exposures of 25 to 100 or more hours. By using a more efficient arrangement we have been able to reduce the exposures from hours to minutes and even to seconds. The liquid is contained in a cylindrical tube placed parallel and very close to a brilliant quartz-Hg arc. Both are surrounded by cylindrical metal mirrors and the entire system is immersed in running water for temperature control. Scattered radiation passes from the end of the tube directly into the spectrographs. This arrangement, together with the Hilger E_2 spectrograph gives the stronger of the modified lines characteristic of different liquids with exposures of a few minutes, and satisfactory results with a 21-foot concave grating spectrograph have been obtained with exposures of 1 to 2 hours. Spectrograms have been made of Hg light scattered in C_6H_6, CCl_4, $CHCl_3$, H_2O, H_2SO_4, HNO_3, KNO_3, $NaNO_3$, KNO_2, SiO_2 and $CaCO_3$.

The wavelengths of modified radiations have usually been given only two to four figures but it is found that some lines are surprisingly sharp and can be measured to about one part in 300,000. This precision corresponds to about 0.1 $cm.^{-1}$ in wave number, which in turn corresponds to $10^{-4}\mu$ at 3μ or $10^{-3}\mu$ at 30μ.

The first explanation for the modified lines in the spectrum of scattered light was that a molecule may subtract from or add to an incident quantum one of its characteristic energy quanta and scatter the resultant sum or difference in a single quantum. Although only qualitative data were heretofore available, certain difficulties and discrepancies in the correlation of modified lines with infrared absorption bands were apparent. More precise measurements indicate that the frequency shifts may be interpreted not only as absorption frequencies but also as differences between these. If this revised interpretation is correct the significance and power of the experiments with scattered light in unravelling infrared spectra are very much increased. (*Author's Abstract.*)

990TH MEETING

The 990th meeting was held in the Cosmos Club Auditorium, April 13, 1929.

Program: H. A. MARMER, *The Gulf Stream and its problems.*—The prevailing conceptions in regard to the Gulf Stream date back to the conclusions derived about forty years ago, at which time the last of an extensive series of observations was made. Since then, however, our knowledge of many of the

factors involved have undergone considerable modification, and hence the prevailing notions regarding the Gulf Stream must be modified accordingly. The paper discussed the various factors and problems involved. It is to appear in an early issue of the Geographical Review. (*Author's Abstract.*)

F. C. BRECKENRIDGE, *Visibility tests with flashes from neon and incandescent Lamps.*—The visibility of light derived from an incandescent lamp with a red filter has been tested in comparison with that of light from a neon lamp and also with that of a similar incandescent lamp without the filter. Especial attention was given to producing beams having similar candlepower distributions. The tests include a variety of clear, hazy, rainy and foggy weathers and ranges up to 7.0 km.

The results of the test indicate no difference between the visibility of light from a neon lamp and light of the same color and horizontal intensity distribution from incandescent lamp with a filter. The use of the red filter on an incandescent beacon did not increase its visibility under any of the weather conditions encountered, but there was some evidence that it did not reduce the range as much in certain types of foggy or hazy conditions as it did in clear weather.

The neon lamp will produce red light more efficiently than the combination of incandescent lamp and filter. The relatively low brightness and conventional form of the neon lamp, however, are drawbacks for use with lenses and reflectors. The red filter makes the flash more conspicuous and that in many locations more than offsets the loss in range. (*Author's Abstract.*)

F. C. KRACEK, *The polymorphism of sodium sulphate.*—Anhydrous sodium sulphate exhibits complex polymorphism. The behavior of individual samples depends upon their previous thermal history as well as upon their mode of preparation. Heating and cooling curves show radically different individual characteristics. The first heating curve on material crystallized from aqueous solution has six heat absorptions between 195° and 250°. These fall into two major groups; the upper group only is partially reversible on reheating after cooling. The cooling curves always have at least two heat evolutions in close proximity, one of which is the well known arrest at 234°. The thermal evidence combined with microscopic examination leads to the conclusion that this salt is pentamorphic. The three lower forms exhibit pseudomonotropism. None of the inversions are rapid in the dry state, and all show appreciable hysteresis. (*Author's Abstract.*)

991ST MEETING

The 991st meeting was held in the Cosmos Club Auditorium, April 27, 1929. *Program:* JAMES B. MACELWANE, S. J., Professor of Geophysics and Dean of the Graduate School of St. Louis University, by invitation: *Work of the Jesuit Seismological Association.*—It is now just twenty years since the Reverend Frederick L. Odenbach, S. J., of John Carroll University, Cleveland, Ohio, began the movement which has resulted in the present association. February 2, 1909, he addressed a circular letter to the presidents of the Jesuit colleges and universities in the United States and Canada on the possibilities of seismological research. He stressed the advantages of a cooperative program with similar instruments, and told them of the extremely low prices at which the small Wiechert seismographs could be purchased. The result was that in less than two years fifteen institutions purchased horizontal component seismographs. These were Brooklyn College (Brooklyn, N. Y.), Canisius College (Buffalo, N. Y.), Fordham University (New York City),

Georgetown University (Washington, D. C.). Gonzaga University (Spokane, Wash.), Holy Cross College (Worcester, Mass.), John Carroll University (Cleveland, O.), Loyola University (Chicago, Ill.), Loyola University (New Orleans, La.), Marquette University (Milwaukee, Wis.), Regis College (Denver, Colo.), Saint Boniface College (Saint Boniface, Man., Canada), Saint Louis University (Saint Louis, Mo.), Saint Mary's College (Saint Mary's, Kan.), Spring Hill College (Mobile, Ala.), and the University of Santa Clara (Santa Clara, Calif.). Three of these, Georgetown, New Orleans and Santa Clara also purchased vertical component seismographs of the Wiechert type.

The first organization with headquarters in Cleveland under Father Odenbach was called the Jesuit Seismological Service. It worked very well for two years until an unfortunate difference of opinion brought it to a premature end. Left to their own initiative one after another of the stations stopped publishing results or ceased operation altogether. Only Georgetown, Denver, Spring Hill and Saint Louis were still publishing data in 1925. There was danger that the chain of stations as such would prove a wasted effort.

Largely through the initiative of Doctor Arthur L. Day and Mr. Harry O. Wood of the Carnegie Institution of Washington, an exchange of views between the directors, the Jesuit superiors and the speaker was begun in the spring of 1925, which resulted in the formation of the present Jesuit Seismological Association as a voluntary organization of stations, not of men, with a central station at Saint Louis University. The cooperation of Science Service and of the United States Coast and Geodetic Survey, and the proposal made by them to unite with the new association in a plan for the immediate determination of epicenters, helped much in bringing about the reorganization.

Of the twelve stations now in operation, Cincinnati is entirely new and Georgetown, Fordham, Santa Clara and Saint Louis have new, first class equipment. The results so far obtained are highly encouraging, and it is hoped that the presence and activities of these stations in the colleges and universities will lead promising students to take up the study of seismology. (*Author's Abstract.*)

992D MEETING

The 992nd meeting was held in the Cosmos Club Auditorium, May 11, 1929.

Program: HOWARD S. RAPPLEYE: *The mathematical and graphical features of genealogical research.*—This paper represents an informal discussion of certain mathematical and graphical features in connection with the tracing out of family trees and their representation on diagrams of workable size. The mathematical feature of the paper consists almost entirely of a brief discussion of the rate at which the number of ancestors for any given individual increases as one goes backward generation to generation. For the given individual the number of ancestors involved in going back two or three centuries is not beyond the practical limits set by the ability of any one individual to cover the ground, but from that point on the amount of labor involved in looking up double the number of ancestors in each succeeding generation piles up so rapidly as to be entirely out of the question for any individual research.

The portion of the paper dealing with the graphical representation of family trees is illustrated by means of a number of large poster diagrams on which portions of family trees are shown. These illustrate the various types

of diagrams from the simplest or "pedigree diagram" to the more complicated types which attempt to show all of the descendants of some common ancestor. The pedigree type of diagram is useful in tracing the descent of the modern individual to some illustrious ancestor.

The type of diagram on which most emphasis is laid represents at its point a modern individual and attempts to represent all of his ancestors back to the limit of the diagram.

A suggested form of individual record card is also presented with some suggestions as to a convenient numbering system for individual records in the case where the research is covering or attempting to cover the complete ancestry of some present-day individual. (*Author's Abstract.*)

D. B. Judd: *Recent developments in color theory.*—It is said (Allen) that between 60 and 70 theories of color vision appear in the literature. Of these, the author is somewhat familiar with ten. These theories differ notably with respect to the seat which is chosen for the mechanism that is taken to explain the principal facts of color vision. These facts, for the sake of simplicity in discussion, may be grouped into two heads: (1) the laws of mixture of color stimuli which indicate a system having three degrees of freedom, and (2) the subjectively discovered fact that two pairs of chromatic primaries exist, red and green, yellow and blue. Thus the original Young-Helmholtz theory (still held in different modifications by Tscherning and Allen) spoke of three types of nerve endings in the retina whose various responses (red, green, and violet) were fused in the visual cortex into colors as we experience them. The later Helmholtz view places all three types of response together with their fusions within a single cone-shaped receptor cell of the retina, as does also the Ladd-Franklin view. The theory of Adams assumes three types of receptor cells whose responses are fused by means of synapses within the nerve-tissue layer of the retina itself. The Hering theory which assumes the existence, somewhere in the chain of retinal and post-retinal events, of three reversible processes, red-green, blue-yellow, and black-white, has been rather generally confined by his immediate successors (Tschermak, Müller) to the cortex; but W. T. M. Forbes has recently supplied a possible retinal mechanism based on interference which also yields closely the Hering formulation. Moreover, V. Kries, followed by Schrödinger (of wave-mechanics fame), is inclined to carry on a Young-Helmholtz theory for the retina and a Hering theory for the cortex. All of these various formulations account for the principal facts of color vision; some rather more naturally emphasize the three degrees of freedom of the visual system, others more easily suggest the two pairs of chromatic primaries. The accessory phenomena (after-images, contrast, fatigue, color-blindness, etc.) are judged to be well or ill explained by all these theories depending in large measure on the pre-conceived ideas of the judge.

Recently Selig Hecht has demonstrated that binocular fusion of colors is easy for the normal observer to experience. He indicates that, since this kind of fusion undoubtedly occurs in the cortex, he is inclined to refer all color-fusion to that region. Thus, we may perhaps expect him to return to the original Young-Helmholtz formulation, though, to be sure, of those mentioned only the later Helmholtz, the Ladd-Franklin, and the Adams views refer color-fusion specifically to the retina. Ladd-Franklin has since opposed Hecht's argument by pointing out that his experimental conditions were responsible for the success of his observers with binocular fusion of colors. Rivalry and dominance, rather than fusion, are to be expected for other experimental conditions.

The Ladd-Franklin theory has also been newly attacked by G. E. Müller, who incidentally describes a sort of color deficiency (blue-yellow), lately discovered, which he names Tetartanopia as distinguished from the better known blue-yellow deficiency, Tritanopia. Müller has elaborated the Hering theory by carrying on one Hering formulation for the retina and another (with slightly different primaries) for the cortex. According to this view, Tritanopia is due to the failure of the retinal, blue-yellow process, while Tetartanopia is due to failure of the cortical, blue-yellow process. Müller's views are particularly interesting because experiments at the Bureau of Standards along different lines have independently suggested the need for similar views. (*Author's Abstract.*)

OSCAR S. ADAMS, *Recording Secretary.*

BIOLOGICAL SOCIETY

728TH MEETING

The 728th meeting was held in the new assembly hall of the Cosmos Club January 12, 1929, at 8.10 p.m., with President GOLDMAN in the chair and 70 persons present.

PAUL BARTSCH reported the appearance of the same mocking bird at his feeding shelf for the ninth or tenth year.

HOWARD BALL reported the observation of the following birds: Forster tern near Hunting Creek on 28 December; phoebe, chewink, and catbird on 5 January near Washington; a duck hawk on the post office tower.

Program: P. S. GALTSOFF: *Private life of the American oyster* (illustrated).—An understanding of the factors controlling the life of any organism in the sea requires a thorough knowledge of its physiology and of the seasonal changes that take place in its environment. Such an attempt was made by the author in a study of the life history of the American oyster which because of its wide distribution and abundance plays an important part in the life of our inshore waters.

Quantitative experimental studies on feeding, spawning and sensitivity of the oyster carried out during the last three years at Woods Hole, Mass., enabled the author to describe these activities in the oyster as they occur in nature. It has been found that feeding which consists in filtering of water through the gills and swallowing the microorganisms suspended in water, is controlled by the temperature and ceases entirely at 5°C. The maximum activity of the gills occurs around 25° when the oyster can take in water at the rate of about 4 liters per hour. On a crowded reef millions of gallons of water are filtered daily by the oysters and it happens often that in shallow bays with small range of tides there is not sufficient water available for the oysters which have to live on a reduced diet and starve.

Spawning of the oyster is controlled by the temperature and by the presence of eggs and sperm in the water. The female oyster is unable to spawn at the temperature of 20° or below. Above this temperature limit its spawning can be caused by adding a small amount of sperm to the surrounding water. Spawning reaction is characterized by a long latent period, rythmical contractions of the adductor muscle and discharge of eggs. The reaction is followed by a period of rest which lasts from 2 to 4 days. During this time the oyster is unsusceptible to the sperm. Male oysters can be induced to spawn by adding small amounts of eggs. The reaction takes place almost immediately and consists in the discharge of sperm; it is not accompanied by the contraction of the muscle and is not followed by the period of rest.

Oysters were found to be very sensitive toward slight changes in the chemical composition of sea water, especially to the increase in concentration of potassium salts.

Intimate knowledge of the activities of the organism is essential for understanding the factors that control its life in the ocean. (*Author's abstract.*)

H. F. PRYTHERCH: *Forecasting the time of setting of oysters* (illustrated).—The oyster industry is our most valuable fishery and represents the highest development in the field of agriculture. The oyster lends itself readily to cultivation and the oyster farmer in taking advantage of this has not only made productive thousands of acres of barren bottom in our coastal waters but has increased the production on depleted natural oyster beds from 10 to 100 times. In the waters of Long Island Sound which border the shores of Connecticut we find oyster farming developed to a greater extent than anywhere else in the world. In the past, Connecticut has been famous as a seed oyster producing region and was able to supply the surrounding states and even Europe with this commodity. However, in recent years seed oyster production has decreased to such an extent that the oyster growers have failed to obtain enough seed for the planting of their own grounds and as a result the bottom acreage leased for cultivation has decreased since 1910 from 75,000 acres to 50,000 acres in 1928. The Bureau of Fisheries, in response to requests from the oyster growers, established a field station at Milford, Conn., and proceeded to study (1) the fluctuations in the yield of seed oysters from year to year; (2) the relation between the hydrographic conditions over the oyster beds and these fluctuations; (3) the time of oyster spawning; (4) the occurrence, distribution and behavior of the oyster larvae; and (5) the time of setting or attachment of the oyster larvae to the collecting material that is planted by the oysterman.

I will only have time to discuss briefly the factors that were found to be of greatest importance, as a result of which we have been able to supply the oysterman with advance information as to: (1) Whether there will be a crop of seed oysters and how heavy it will be; (2) when the oysters will spawn; and (3) when setting will occur or in other words, the time by which shell planting should be completed. To arrive at these conclusions over a month in advance, the chief factors that are analyzed are: (1) the quantity of adult oysters and their location; (2) the amount of spawn developed by the oysters; (3) the temperature of the water; and (4) the range of tide.

From a correlation of these factors with the time of spawning and the yield of seed oysters during previous years we have been successful in making predictions for the summers of 1926, 1927 and 1928. The past summer was a rather severe test for forecasting as will be seen from the graphs but fortunately turned out correct and gave additional evidence in support of the method that was employed. The predictions are turned over to the state shellfish commission which issues copies to all the oyster growing concerns which engage in shell planting. (*Author's abstract.*)

G. C. ROUNCEFEL: *Alaska herring investigations.* (No abstract received.)

S. F. BLAKE, *Recording Secretary.*

729TH MEETING

The 729th meeting was held in the new assembly hall of the Cosmos Club January 26, 1929, at 8.10 p.m., with President GOLDMAN in the chair and 55 persons present. New member elected: M. G. NETTING.

FRANK THONE described briefly some new scientific publications.

Mrs. T. M. Knappen reported the recent observation of a towhee in Washington on Tilden Street.

E. P. Walker: *Some graphic methods of showing problems in wild life administration.*—Due to the failure of the masses of the American public to grasp the problem involved in wild life administration, efforts have been made to present some of them graphically. Four problems were thus presented in diagrams or graphs. The graph of the first subject was based on the premise that a given area of land or water or land and water will support a certain animal population. Increase of the population exhausts the food supply and if the area is not fully stocked there is an economic loss.

The second problem, the fur cycle, illustrated graphically the changes in the value of the skin of a number of land fur-bearing animals, depending upon the dates the animals were killed. This illustrated the growth and priming of the fur until it was at its maximum value for a very short period, and its wearing, fading, and shedding.

The third problem, a basis for adjusting fur seasons, was illustrated with graphs showing relative numbers of animals taken during the first, second, and third months of an open season.

The fourth problem, studies of Alaska fur production, used the three preceding ones for a basis and showed that with the proper adjustment of the seasons for the taking of certain animals a greater cash return can be obtained from a smaller number of animals taken over a short season than from a larger number of animals taken over a longer season; thereby showing the importance of properly adjusting the seasons for taking fur-bearing animals and that such seasons and takes, when properly adjusted and limited, will result in much greater profit than when the seasons are not properly adjusted and the takes thereby limited. (*Author's abstract.*)

O. J. Murie: *The Alaska caribou* (illustrated).—The caribou occupy the rounded open hills of interior Alaska, although they occur at times in more limited numbers in the high rugged mountains inhabited by the mountain sheep. In summer they feed largely on grasses and herbaceous plants. They are fond of willow in the fall. When snow covers the ground the caribou promptly shift to new feed grounds, seeking the areas where lichens are available. Although lichens are the favorite food in winter, great quantities of grass are also eaten. It is necessary at this time for the animals to paw through the snow with their front feet.

The Indians formerly snared the caribou. A fence several miles long was often built and at frequent intervals a gap was left in which was placed a snare. The caribou, traveling along the fence which they find in their path, encounter an opening and in attempting to pass through, become ensnared. Caribou have been snared in recent years, but the Indians no longer depend on this method of securing game. (*Author's abstract.*)

Professor James G. Needham of Cornell University, spoke of the lack of knowledge of local biology in China. Most of the instruction in the schools and universities seems to refer to animals and plants of the United States or Europe.

730th meeting

The 730th meeting was held in the new assembly hall of the Cosmos Club February 9, 1929, at 8.05 p.m., with President Goldman in the chair and 63 persons present.

Howard Ball reported the recent observation of the Holboell and horned grebes in the Tidal Basin.

T. S. PALMER: *Some early collectors and recent changes in wild life conditions in the District of Columbia.*—(No abstract received.) Discussed by C. W. STILES.

W. P. TAYLOR: *Important wild life problems in Arizona.*—(No abstract received.) Discussed by T. S. PALMER and C. W. STILES.

The chairman introduced Dr. T. GILBERT PEARSON who announced the passage by both houses of the Game Refuge Bill.

731ST MEETING

The 731st meeting was held in the new assembly hall of the Cosmos Club February 23, 1929, at 8.10 p.m. with President GOLDMAN in the chair and 113 persons present.

The deaths of Dr. FREDERICK A. LUCAS and DR. JONATHAN DWIGHT were announced.

The regular program was as follows:

J. C. MERRIAM: *Opportunities for inspirational education at the Grand Canyon (illustrated).—(No abstract received.)*

VERNON BAILEY: *Present conditions of animal life of the Grand Canyon (illustrated).*—The speaker exhibited lantern slides showing life zones of the general region from the Lower Sonoran Zone in the bottom of the Canyon, the Upper Sonoran Zone of the side slopes and the Painted Desert, the Transition Zone of the plateau top on both sides of the Canyon and around the base of San Francisco Mountain, the Canadian Zone top of the Kaibab Plateau and middle belt of San Francisco Mountain, the Hudsonian Zone at timberline and the Arctic Alpine peaks of the mountains above timberline. The point brought out was that here in a fifty mile section of about 10,000 foot rise in altitude were climatic conditions corresponding to those of a north and south section from the Gulf of Mexico to the Arctic Barren Grounds.

With this wide range of climate a correspondingly great variety of animal and plant life is found and some of the conspicuous species of mammals and reptiles were shown and their zonal ranges discussed. The Grand Canyon as a barrier to distribution was shown by the different species of mammals occurring in the Transition Zone on the two sides at the top separated by the hotter zones below while most of the species of mammals and reptiles of the Lower Sonoran Zone at the bottom of the Canyon occur on both sides of the river. This clearly demonstrates that it is climate and not the river acting as a barrier to keep apart such distinct species as the Abert and Kaibab squirrels, the fulvous and Colorado pocket gophers, and many other mammals on the north and south rims of the Canyon.

Among other animals the mule deer of the Kaibab Plateau were mentioned as of great interest to the thousands of visitors during the summer and lantern slides were shown of some magnificent old bucks with full grown branching antlers. The native mountain sheep and antelope are less numerous but some day it is hoped they will increase to such numbers that they may be seen by all visiting tourists. At present the animal life including at least the mammals, birds, and reptiles, forms a great attraction at the Grand Canyon National Park and these are being protected and encouraged in a way to promise great interest and educational value for future generations. (*Author's abstract.*)

The papers were discussed by C. H. MERRIAM and C. D. MARSH.

A. A. DOOLITTLE, *Recording Secretary pro tem.*

732D MEETING

The 732d meeting was held in the new assembly hall of the Cosmos Club March 9, 1929, at 8.20 p.m., with President GOLDMAN in the chair and 46 persons present. New member elected: C. E. BURT.

Mrs. T. M. KNAPPEN reported the recent observation of thousands of White Ibis in the vicinity of St. Johns River, Florida. Large flocks passed over continuously for about 20 minutes. She also observed a flock of about 200 in Georgia.

A. A. DOOLITTLE reported the observation of a Black-crowned Night Heron in the zoological park during the last week in January.

A. WETMORE reported that the new bird cage at the zoo is practically completed, and that an appropriation of $220,000 is available to build a house for invertebrates and reptiles.

HOWARD BALL gave an account of birds recently observed at Brigantine Beach.

P. B. JOHNSON stated that he had recently seen a muskox at the zoo charging in heavy snow.

The regular program was as follows:

F. C. LINCOLN: *Some causes of bird mortality* (illustrated).—The causes of bird mortality are of interest to every ornithological student. It is axiomatic that there is a large death rate from natural causes and the entrance of man into the picture adds additional hazards to the lives of birds while at the same time removing or controlling others.

Since the bird-banding work was taken over by the Bureau of Biological Survey more than 431,000 birds have been banded, to which may be added 22,500 marked with bands of the old American Bird-Banding Association, giving a grand total of more than 453,600. Of these, return records are available to the number of more than 24,500. Of these returns, 3,156 represent dead birds of the smaller land bird groups and the paper dealt entirely with these, thus eliminating consideration of all birds that are shot as game and others that because of their size are usually victims to gunners.

The number of small banded birds that have been shot was 561, and because of the fact that in most parts of the country blackbirds, starlings, and blue jays are considered as legitimate targets it would seem worth while to subtract the total of such birds from this list, and also the robin, which is still occasionally hunted in southern States. This leaves the insignificant remainder of 57 small song birds that have been shot. The number of small banded birds that have been reported as being killed by cats is 245, which with the exception of shooting is a larger figure than almost all other causes together. This is by far the most serious item on the list, so far overshadowing all other known causes of small bird mortality as to force them entirely into the background.

Banded birds killed by flying into windows, wires, and so forth numbered 67; killed by storms 70; killed by boys with airguns, slingshots, and other juvenile weapons 60; by automobiles and trains, 55; in traps set for other animals 52; by starvation 26; by drowning 19; by being entangled in strings and nesting material 11; by freezing 9; by poison 8; and by collection of scientific specimens 7. The last figure is of peculiar significance when it is recalled that collectors of scientific specimens are frequently accused of destroy-

ing a very large number of small birds. Evidence here presented is, however, seven out of more than 300,000.

Under some miscellaneous causes of death to small birds it is interesting to note that domestic poultry is tied for first place with bronzed and purple grackles. Snakes, bluejays, lawnmowers, seines, golf balls, and various other unusual factors have entered into the death of some of these small banded birds.

It should be borne in mind that a banded bird is literally a marked bird, particularly when in the vicinity of a trapping station, as the neighbors of such a station will consistently coöperate in assisting the operator to keep in contact with birds wearing bands. For this reason a dead bird which when found on the lawn or in the yard of the average home is merely a bit of rubbish to be disposed of as promptly as possible becomes an object to demand attention and if banded to be reported to the station operator or to the Survey. (*Author's abstract.*)

In discussion, A. WETMORE stated that according to his observations the mortality from automobiles was increasing rather than decreasing, apparently due to the general increase in speed. The mortality in early summer appears to be due in part to the large number of young birds and possibly also to the frequency with which birds feed in the road on insects killed at night. C. W. STILES stated that practically all the deaths considered in Mr. LINCOLN's paper were violent deaths and asked what became of the birds that died from the numerous avian diseases, such as cestode intestinal tuberculosis, avian tuberculosis, avian malaria. Dr. WETMORE replied that the bodies of birds dying either natural or violent deaths were quickly disposed of by other animals.

W. B. BELL: *Present needs in biological research.*—The speaker outlined briefly the general biological field and reviewed some of the outstanding developments in the history of biological sciences which led up to conditions existing at the present time. He stated that the purpose of the discussion was to bring out from people representing divers interests in biological sciences an expression of their views regarding the features which should receive consideration by an organization such as the Biological Society, which represents all lines of biological inquiry and development.

In view of the remarkable expansion in support of biological research during recent years the speaker emphasized the need for planning and organization of research work in such a way that the important fields would be adequately covered, the work so coördinated that accumulated results would represent a well-rounded biological structure and at the same time maintain conditions in research which stimulate individual initiative.

In presenting features in which the speaker was primarily interested emphasis was placed on the importance of thorough study of the natural history and ecological relationships of the vertebrate groups. These should include collection and identification and study of the relationship which the animals sustain under natural conditions to one another and to plant conditions such as forestry, forage, and cultivated crops. A number of pressing problems, including diseases, were mentioned to illustrate the need for thorough study employing the best known technical methods and mechanical equipment in assembling and checking up data which might prove helpful in meeting the present need for constructive action in placing wild life administration on a sound footing. (*Author's abstract.*)

Discussed by C. W. Stiles, who summarized the different meanings that had been attributed to the word biology; by Vernon Bailey, who emphasized our ignorance of the life history of even our most common mammals; and by A. Wetmore, who stressed the need for systematic study in most of the lower groups of animal life.

S. F. Blake, *Recording Secretary.*

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CHEMISTRY.—*The determination of small quantities of selenium in ores.*[1] E. Theodore Erickson, U. S. Geological Survey. (Communicated by R. C. Wells.)

For a number of years a mixture of three or four parts by weight of zinc oxide and one part of sodium carbonate has been used in smelter laboratories to effect the decomposition of ores and concentrates, through sintering, in the determination of sulfur and arsenic. This method, which resembles the well known Eschka method for sulfur in coal, was devised by Clarence B. Sprague,[2] who also developed at the Midvale (Utah) plant of the U. S. Smelting and Refining Co. the scheme of neutralization by zinc oxide to permit the bag house filtration of smelter fumes.

While working at Midvale a number of years ago the writer performed some experiments to test the applicability of the Sprague method of sintering to the determination of other elements than sulfur and arsenic that might form water-soluble compounds, during the course of which the adaptability of the method to selenium was indicated. The selenium extracted as sodium selenate was subsequently precipitated as barium selenate, or as selenium with sulfur dioxide in the presence of concentrated hydrochloric acid after partial evaporation of the solution. Further tests made recently show that the method is both accurate and sensitive. It is now being used to determine small percentages of selenium, ranging from 1 or 2 thousandths to 0.002 per cent, in zinc sulfide ores, in connection with a study being made by C. E. Siebenthal, of the U. S. Geological Survey.

[1] Published by permission of the Director, U. S. Geological Survey. Received July 3, 1929.

[2] W. C. Ebaugh and C. B. Sprague. *The use of sodium carbonate and zinc oxide in sulfur and arsenic determinations.* Journ. Amer. Chem. Soc. **29**: 1475. 1907.

ANALYTICAL PROCEDURE

Twenty-five grams of the zinc ore sample are ground in a mortar with 80 grams of the sintering mixture composed of three parts of zinc oxide and one part of sodium carbonate. A further quantity of 80 grams of the sintering mixture is added by rolling with the ground portion on an oil cloth. The use of a total of 160 grams of the sintering mixture with 25 grams of zinc sulfide ores has been found to provide sufficient excess of sodium carbonate for the formation of sodium sulfate and other reactions that occur during the sintering treatment.

The mixed materials are placed in a porcelain dish and heated slowly in a muffle to about 700°C. During the following hour the mixture is stirred two or three times with a spatula while the temperature is raised to about 750°. A glow caused by the oxidation of the sulfide becomes visible at about 700° and slowly spreads through the contents of the dish. The temperature is then finally raised to 800° for about half an hour.

The mixture is cooled in the muffle to prevent the breakage of the dish, and then repeatedly extracted with hot water which is passed through a filter until about 900 cc. of filtrate is obtained. The filtrate is made slightly acid with hydrochloric acid and evaporated until there remains a mixture of salts and about 20 cc. of solution. This mixed residue is transferred to a mortar with the aid of 25 cc. of concentrated hydrochloric acid, thoroughly ground and filtered into a 250 cc. beaker. The insoluble salts are again ground with 20 cc. of concentrated hydrochloric acid, transferred to the filter and allowed to drain.

The next step is to precipitate the selenium with sulfur dioxide. The solution is first saturated with the gas, then allowed to stand over night, when it is briefly warmed and again saturated with the gas. For the most delicate indications of color this treatment is repeated two or three times during the course of about ten days.

OBSERVATIONS

During this treatment it was noticed that when very large samples were used the selenium tended to collect in any silica that might be present and its visibility was apparently thus increased. Some samples yielded sufficient silica for this purpose. However, if any did not, a little silica gel was added,—just enough to cover the bottom of the beaker. A few samples yielded rather too much silica. Another portion of such a sample was sintered again for a longer time over the

low-temperature range, with frequent stirring, which appeared to reduce the soluble silica considerably.

Occasional samples which were shown to contain tungsten yielded a bright yellow color with the silica gel before sulfur dioxide was added, probably caused by yellow tungstic oxide. This suggests the possible use of silica gel in collecting such compounds for colorimetric or other estimation.

The smaller quantities of selenium were estimated by comparison with two series of blank tests with known quantities: one using 25 grams of a zinc ore practically free from selenium and the other using the sintering mixture alone. One-fourth of a milligram of SeO_2 to 25 grams of ore (0.001 per cent SeO_2) imparted a distinct red to the silica gel. Half this quantity gave a slight perceptible color, and less than .0002 per cent gave an uncertain indication, reported as doubtful trace. Many ores showed no selenium whatever by this method.

FUNCTION OF THE ZINC OXIDE

The zinc oxide component of the sintering mixture, like magnesium oxide in the Eschka mixture, because of its infusibility, maintains a porosity during the sintering treatment and so assists in oxidation by atmospheric oxygen. Some have supposed that it also assists through catalytic action, and the writer is inclined to this view. Its use as a catalyst in some reactions is well known.[3] Scintillation of the zinc sulfide mixtures occurs at the surface when they are heated somewhat below 700°, and around this temperature a glow begins. The catalytic action of zinc oxide may be related to a tendency to form a peroxide. Its change from white to yellow on heating is well known, and this change may have some bearing on its catalytic action.

CHEMISTRY.—*Origin of helium-rich natural gas.*[1] R. C. WELLS, U. S. Geological Survey.

The presence of helium in natural gas, mine gas, and gases from springs, earth vents, and most other natural sources has puzzled many investigators. As helium is formed in radioactive changes its occurrence in natural gas suggests the reasonably near presence of radio-

[3] R. L. BROWN and A. N. GALLOWAY. *Methanol from hydrogen and carbon monoxide*, Ind. Eng. Chem. **20**: 960. 1928.

[1] Published by permission of the Director, U. S. Geological Survey. Received July 8, 1929.

active substances, but all who have studied the subject have realized that some special or unusual conditions must be assumed to explain the higher concentrations found in a relatively few localities. The object of the present note is to discuss the part that diffusion may play in concentrating helium under special conditions.

Moureu[2] early pointed out that the helium content of fire damp and the gases of mineral springs bears no quantitative relation to known radioactive elements in the associated coals or mineral waters. Such helium, he concludes, must represent part of the earth's store of old "fossil" helium. Rogers,[3] considering especially the Petrolia field in Texas, held that the helium can most reasonably be accounted for by a local deposit of pitchblende, or its equivalent, and estimates that about 120 million tons would suffice—that is, a seam 10 miles long, 10 miles wide, and 2 inches thick, or its equivalent. Lind[4] is inclined to follow the earlier theory of Cady and McFarland in holding that normally disseminated radio-elements can account for the helium, and that they very likely account for some of the associated nitrogen, set free by the bombarding action of alpha particles.

A question arises at this point relating to "normally disseminated radio-elements." What is actually measured is radon, the radium emanation, a gas of the helium family continuously generated from radium, but for geologic discussion such measurements show the very wide distribution of uranium. Yet particles of uranium minerals in ordinary rocks can seldom be recognized with the microscope, even when the test for radioactivity is positive. Hence their volume is insignificant. Bearing the last statement in mind, the reader may recall that Chamberlin[5] found all rocks to contain measurable quantities of gas, of the order of a half to several times the volume of the rock, over and above any present in the pores. It is true that a large part of the gas was set free, as shown by his experiments, only at temperatures above 500°C., but if we allow for the sake of argument that gas to the amount of one-tenth the volume of the rock would be available during geologic periods for "sweeping out" the helium, simple calculation shows that the proportion of helium so obtained would be small, probably much smaller than that in the helium-rich gases. The "sweeping" action of the helium itself would be negligible.

[2] *The rare gases of natural gas.* Journ. Chem. Soc. **123**: 1905. 1923.

[3] G. S. Rogers. *Helium-bearing natural gas.* U. S. Geol. Surv. Prof. Paper **121**. 1921.

[4] Proc. Nat. Acad. Sci. **11**: 772. 1925.

[5] Carnegie Inst. Washington Publ. **106**.

From these considerations it seems more reasonable to postulate deposits of uranium and thorium ores as the source of the helium, if no new feature is added to the theory, but the existence of such deposits is pure assumption. On the other hand, a theory that will explain the concentration of helium in gases containing very small quantities of it leaves little to be desired.

The incentive to regard diffusion as an important factor in such concentration came from the work of Williams and Ferguson[6] and others who have shown that silica and glass become remarkably permeable to helium at moderately high temperatures. Strange to say, helium diffuses through silica and glass even faster than hydrogen, the molecular weight of which is half that of helium.

According to Williams and Ferguson the permeability of silica glass to helium becomes appreciable at 180°C., and that to hydrogen at 300°. At 500° the permeability to helium is over 20 times that to hydrogen.

We may suppose, then, that when deeply buried rocks become heated, as they evidently have been during certain geologic epochs in some localities, helium would have a particular and special tendency to escape at one stage of the heating, say 200°, and if then collected and trapped by overlying impermeable barriers in a cooler environment would constitute a helium-rich gas.

A considerable rise of temperature would set free most of the helium of uraniferous minerals but might also produce igneous activity and possibly result in a nearly complete loss of the gas in steam and lava, whereas a moderate rise would merely make the minerals and rocks permeable to the helium. Hence the largest concentrations of helium need not be expected in areas of marked igneous activity, and Rogers has pointed out that the Petrolia field seemed to agree with this view. According to recent information, on the other hand, the Amarillo fold, in which the helium content is higher than that at Petrolia, lies immediately over an old buried granite ridge.[7]

The rate of diffusion of helium through silica glass at 500°C. found by Williams and Ferguson is 0.0056 cc. per hour per square centimeter per millimeter of thickness, from atmospheric pressure to a vacuum. The corresponding rate for hydrogen is 0.0002 cc. Nitrogen and oxygen have much smaller rates.

This suggested possible application of diffusion through silica leads

[6] Journ. Amer. Chem. Soc. **44**: 2160. 1922.

[7] Ruedemann and Oles. Bull. Amer. Assoc. Petroleum Geol. **13**: 799. 1929.

to what is obviously of even more probable applicability—diffusion in the pores of rocks. It is well known that gases pass through small openings at rates inversely proportional to the square root of their density (Graham). What does not seem to be generally recalled, however, is that little or no separation of mixtures is obtained in this process unless the openings are below a certain size. Thus, in experiments to separate hydrogen and carbon dioxide the writer obtained no success with a diaphragm of plaster of Paris, but measurable separation was obtained with ball clay.

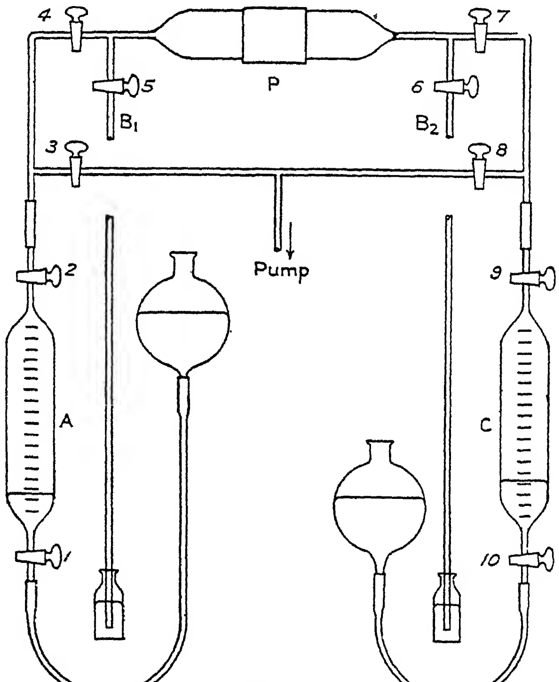


Figure 1.

The apparatus is shown in Figure 1. A is a gas pipette containing a known mixture of gases. P is a cylindrical plug of ball clay or other material cut to just rest between two large glass tubes. This plug is joined to the tubes by, and itself coated with, sealing wax. Over the sealing wax were painted a few coats of celluloid dissolved in acetone, which makes an air-tight covering. C is another gas pipette to receive part of the products of diffusion for analysis. B_1 and B_2 indicate barometric columns, the rate of diffusion being measured by the fall of mercury in B_2 observed with a stop watch.

The plug of ball clay was 3.1 cm. long and had a cross section of 8.6 sq. cm. After the whole apparatus except A was evacuated to a pressure of 3 mm. with all stopcocks except 2 and 10 open, the volume to the right of the plug, including C, was noted. Stopcocks 3, 5, and 8 were now closed. When stopcock 2 was opened some of the gas soon began to diffuse through the plug, and the mercury in column B_2 began to fall. The experiment was ended when desired by closing stopcock 9, thus retaining a fraction of the diffused gas in C for analysis.

TABLE 1.—DIFFUSION OF A MIXTURE CONTAINING 33 PER CENT OF HYDROGEN AND 66 PER CENT OF CARBON DIOXIDE AT 28°C. (EXPERIMENT 25)

Time (minutes)	At left of plug		At right of plug	Volume, V, diffused per minute at 760 mm. (cc.)	$p_1 - p_2$ (atmospheres)	$k = \frac{VL}{(p_1 - p_2)AT}$
	Volume (cc.)	Pressure, p_1 (mm.)	(Volume = 355 cc.) Pressure, p_2 (mm.)			
0	—	—	3	0	—	—
1	192	1028	14	5.1	—	—
3	182	1018	55	5.1	1.30	1.4
4	177	1013	73	7.5	1.25	2.2
5	172	1008	91	8.4	1.22	2.5
6	169	1002	109	8.4	1.19	2.5
7	165	997	125	7.5	1.16	2.3
8	161	993	142	7.9	1.13	2.5

TABLE 2.—RATE OF DIFFUSION OF SINGLE GASES THROUGH A 1-CENTIMETER CUBE OF BALL CLAY AT 27°C., IN CUBIC CENTIMETERS PER MINUTE

Gas	k (Observed)	Theory, $\sqrt{\frac{44}{M}} \times 1.60$
Hydrogen	7.2	7.5
Helium	5.0	5.3
Nitrogen	2.03	2.00
Oxygen	1.87	1.87
Carbon dioxide	1.60	—

Table 1 gives the results of a preliminary experiment.

In the equation for k (Table 1), L stands for length of the plug, A its cross section, and T the time, so that k is the volume of gas in cubic centimeters at a pressure of 76 cm. that will diffuse through a 1-centimeter cube of clay in 1 minute when the pressure gradient is 1 atmosphere per centimeter.

In this experiment, which was stopped after 8 minutes, when 33 per

cent of the mixture had diffused, the resulting gas was found to be 53 per cent hydrogen, whereas the original mixture before diffusion was 33 per cent hydrogen. Corresponding figures found for k for several single gases at 27°C. are shown in Table 2, and also the theoretical rates calculated from that found for carbon dioxide, taking the rate as inversely proportional to the square root of the molecular weight, M.

The results with different mixtures of hydrogen and carbon dioxide are shown in Table 3.

TABLE 3.—Changes in Concentration in Mixtures of Hydrogen and Carbon Dioxide Effected by Diffusion through Ball Clay

Experiment No.	*Temperature (°C.)*	*Initial mixture*		*Time of diffusion (minutes)*	*Final mixture*		*k*
		Volume at 760 mm. (cc.)	*Per cent of hydrogen*		*Volume at 760 mm. (c.c.)*	*Per cent of hydrogen*	
36	30.6	212	2.6	5	26	6	1.74
34	32.8	198	6.3	3	14.5	15	1.74
13	26	200	9.6	16	85	17	1.95
14	27	200	10	12	69	22	1.74
32	31.7	200	10.2	4	23	31	1.97
31	31.7	200	11.5	4	25	36	2.11
15	27	200	12	13	75	25	1.81
16	27	200	16	11	73	30	1.95
17	27	200	20	11	78	39	2.1
33	31.8	199	28.8	3	25	67	2.6
25	27.8	200	33.2	8	66	53	2.4
18	27	200	42	8	74	63	2.7
35	30.6	195	48.8	2	22	84	3.4
19	27	200	65	6	80	81	3.8
28	31.1	200	81	3	53	89	5.1
37	29.4	199	90.2	2	46	94	6.8

These results are conclusive and striking. In every mixture of hydrogen and carbon dioxide tried the first fraction that diffused through the ball clay was richer in hydrogen than the original mixture. Also, the rate of diffusion increases with the proportion of hydrogen, in a way that gives a fairly regular curve when plotted. By collecting enough gas at each stage one could apparently pass, in only seven stages, from 2.6 per cent to over 90 per cent of hydrogen.

Mixtures of helium and nitrogen have not yet been studied, on account of an insufficient supply of helium and analytical complications, but it seems reasonable to expect that helium will behave like hydrogen and that the process of diffusion is therefore worthy of consideration as a natural means of concentrating helium. It is

obvious that if the mixtures on the two sides of the plug were left a long time they would eventually come to the same composition. Therefore in applying the principle of separation by diffusion to natural conditions it is necessary to assume an irreversible flow of gas, such as one that might be caused by some sudden relief of pressure, and that during the course of such a flow the pores gradually become sealed up again so that re-mixing of the gases thus separated is impossible. The localization of gas and oil pools in lenticular sands shows that remarkable differences in pressure and composition are thus preserved for long periods.

The results given above have suggested several further subjects for study which will be taken up as fast as possible. Among these are (1) The behavior of other fine-pored materials, such as shale, slate, and sandstone; (2) the effect of the thickness of the plug; (3) measurements of other gases, including helium and certain light hydrocarbons; (4) adaptation to commercial separations; (5) possible application in the separation of isotopes.

Several papers have been published on the theory of separating gases by diffusion,[8] but the question whether the composition of the porous material modifies the process by adsorption or otherwise seems to have been studied in only one experiment, in which a copper ferrocyanide membrane was used, as described by Lorenz and Magnus.

Summary.—Measurements of the separation of hydrogen from carbon dioxide obtained by fractional diffusion through ball clay were made to illustrate a process by means of which natural gas may become enriched in helium in the earth. The bearing of this theory on other theories of the origin of such gas is discussed. The rate of diffusion of several other gases through ball clay was also measured and several problems are mentioned for further study.

BOTANY.—*New Piperaceae from Central America and Mexico.*[1]
WILLIAM TRELEASE, University of Illinois. (Communicated by PAUL C. STANDLEY.)

On the following pages there are described new species and varieties of the genera *Piper* and *Peperomia*, recognized in collections submitted for study by the Field Museum of Natural History. Most of the plants named as new were obtained on the north coast and in the

[8] MULLIKEN and HARKINS. Journ. Amer. Chem. Soc. **44**: 37. 1922. LORENZ and MAGNUS. Zeit. anorg. allgem. Chem. **136**: 97. 1924.

[1] Received July 26, 1929.

interior of Honduras by Paul C. Standley during the winter of 1927–28. The large number of new forms found in the collection need not occasion surprise if it be remembered that almost no botanical exploration had been conducted previously in Honduras.

Peperomia granulosa Trelease, sp. nov.

A repent-pendulous, glabrous, moderately large, arboricolous herb; leaves alternate, lanceolate, acuminate, acute-based, 2.5 × 6 or the lower 3.5 × 8 cm., pinnately veined, opaque, granular especially beneath; petiole 7–10 or 15 mm. long; spikes terminal, as yet 1 × 35 mm., the stalk 3 cm. long, bibracteate in the middle; bracts round-peltate.

HONDURAS: Lancetilla Valley near Tela, Dept. Atlántida, altitude about 100 m., January 11, 1928, *Paul C. Standley* 54360 (Herb. Field Mus. No. 583, 593, type). Also No. 56566 from the same locality.

Leaves pale green, fleshy; spikes green or pale green.

Peperomia staminea Trelease, sp. nov.

A somewhat cespitose, moderate-sized herb, glabrous except for the puberulent petioles, peduncles, and nodes; stem rather slender (2 mm. thick), drying sulcate-angular; leaves 2–4 at a node, elliptic, obtusely somewhat contracted, acute-based, 1–1.5 × 2–2.5 cm., drying green-papery, 3-nerved beneath; petiole 2–3 mm. long; spikes terminal, 2 × 30 mm., closely flowered; peduncle long (3.5 cm.); bracts round-peltate; stamens oblong.

HONDURAS: On tree in wet forest, Lancetilla Valley near Tela, Dept. Atlántida, altitude about 100 m., January 16, 1928, *Paul C. Standley* 54614 (Herb. Field Mus. No. 583,590, type).

Leaves very thick; spikes bright green; stems reddish.

Piper achoteanum Trelease, sp. nov.

A nodose shrub 2–3 m. tall; flowering internodes short and stout, crisp-pubescent or hirsute, closely pale-granular when denuded; leaves broadly lanceolate, acute, somewhat unequally cordulate, 4.5–5 × 11 cm., pinnately nerved from below the middle, the nerves about 5 + 6, transiently short-pubescent above, becoming granular and lepidote-roughened, hispid beneath with subappressed-hirsute nerves; petiole about 5 mm. long, glabrescent; spikes opposite the leaves, 3–4 × 55 mm., pointed; peduncle 8 mm. long, ascending-hirtellous; bracts round-subpeltate, rusty, ciliolate; flowers sessile, perfect.

HONDURAS: In wet thicket in pine forest, El Achote near Siguatepeque, Dept. Comayagua, alt. 1,500 m., February 18, 1928, *Paul C. Standley* 56125 (Herb. Field Mus. No. 581,879, type).

Piper aeruginosibaccum Trelease, sp. nov.

A shrub 2 m. tall, nodose; flowering internodes rather thick and short, crisp-hirsute-subvillous with white hairs but glabrescent except below the petioles; leaves elliptic, short-acuminate, slightly inequilaterally more or less cordulate, rather large (6–7 × 14–16 cm.), submultiple-nerved from below the upper third, the nerves about 5 × 2 with the lowest approximate, glossy green, paler and glandular-granular beneath with the prominent pale nerves

and cross-veins spreading-hirsute; petiole 5 + 2 mm. long, hirsute; spikes opposite the leaves, 4 × 70 mm., mucronate, rusty; peduncle 5 mm. long, glabrous; bracts subtriangular-subpeltate; flowers sessile, perfect; berries rather large, subglobose with sunken apex, rusty-puberulent; stigmas 2–3, sessile.

HONDURAS: Moist thicket, near La Ceiba, Dept. Atlántida, at sea level, March 11, 1928, *Paul C. Standley* 56735 (Herb. Field Mus. No. 581,616, type).

Spikes pale green; leaves lustrous on the upper surface.

Piper alveolatifolium Trelease, sp. nov.

A shrub 3 m. tall; upper internodes rather slender but short, pale-hispid; leaves broadly lanceolate, gradually and obtusely attenuate, subequilaterally shallow-cordate or cordulate, 7.5–8.5 × 20–22 cm., pinnately nerved from the lower half, the nerves 4–5 × 2, somewhat bullulate, granular-scabrous above, paler green beneath with the very prominent nerves and veins spreading-soft-hairy; petiole 10–15 mm. long, hispid, winged nearly to the blade; inflorescence unknown.

HONDURAS: In thicket along stream, near Siguatepeque, Dept. Comayagua, alt. 1,080–1,400 m., February, 1928, *Paul C. Standley* 56344 (Herb. Field Mus. No. 581,751, type).

PIPER ANGUSTIAE Trelease, var **quiotepecanum,** var. nov.

A much-branched shrub, at most barely puberulent on the young parts; flowering internodes slender and short; leaves round-ovate or ovate, acute to somewhat acuminate, the broad base slightly cordulate, 2.5 × 3.5 or 3.5–4 × 6 cm., drying dull dark green and firm, 5-nerved; petiole 5–10 mm. long; spikes opposite the leaves, 2 × 40 mm., closely flowered; peduncle slender, 5–7 mm. long; bracts concave-subpeltate, dorsally ciliate; berries oblong-ovoid, contracted at apex, glabrous; stigmas 3, large, brown, and sessile.

MEXICO: Pueblo de Quiotepec, Cuicatlán, Oaxaca, alt. 500 m., *H. and C. Conzatti and T. C. Gómez* 2383 (Herb. Field Mus. No. 246,911, type).

Piper aspericaule Trelease, sp. nov.

A shrub 2.5 m. tall, nodose; flowering internodes drying yellowish, persistently hispid and rough; leaves lance- or ovate-subelliptic, sharp-acuminate, obliquely and often very inequilaterally rounded at the base, 5.5–7 × 12–14 cm., pinnately nerved from the lower half, the nerves about 4 + 5, caducously hairy and later granular-roughened above with hispid nerves, the nerves beneath ascending-hirsute; petiole about 10 mm. long, hispid-hirsute, not winged; spikes opposite the leaves, some 3 × 80 mm., cream-colored; peduncle 5 mm. long, scabrid; bracts inconspicuous, rounded-subpeltate, ciliolate.

HONDURAS: In wooded swamp near Tela, Dept. Atlántida, at sea level, January 27, 1928, *Paul C. Standley* 55125 (Herb. Field Mus. No. 583,270, type).

"Cordoncillo." Spikes cream-colored.

Piper atlantidanum Trelease, sp. nov.

A shrub 2 m. tall; flowering internodes moderate, soft-hairy; leaves obliquely subquadrate-ovate, slightly short-acuminate, cordulate with one

side distinctly shorter, 9 × 15–11 × 20 or 13 × 25 cm., pinnately nerved from the lower half, the nerves about 5 + 6, somewhat rugulose, softly crisp-pubescent on both sides but slightly granular above, paler beneath; petiole some 15 + 5 mm. long, soft-hairy, winged toward the base; spikes opposite the leaves, 3 × 70 mm., blunt; peduncle 5 mm. long, crisp-hirtellous; bracts triangular-subpeltate, ciliate; berries trigonous, truncate, brown, glabrous; stigmas 3, minute, sessile.

HONDURAS: In moist thicket, near La Ceiba, Dept. Atlántida, at sea level, March 11, 1928, *Paul C. Standley* 56739 (Herb. Field Mus. No. 581,620, type). Tela, Atlántida, at sea level, *Standley* 56600. Lancetilla Valley, near Tela, in wet thicket, *Standley* 54938. La Fragua, Atlántida, alt. 20 m., *Standley* 55736.

Spikes green or pale green.

PIPER ATLANTIDANUM Trelease, var. **yoroense**, var. nov.

Leaves becoming relatively narrower (10 × 22 cm.) and then not cordulate.

HONDURAS: Wet thicket near Progreso, Dept. Yoro, alt. 30 m., January 24, 1928, *Paul C. Standley* 55073 (Herb. Field Mus. No. 583,981, type).

A shrub 2 m. high; spikes pale green.

Piper atrichopus Trelease, sp. nov.

A bushy, nodose, quite glabrous shrub 2–3 m. tall; flowering internodes slender and short; leaves lanceolate, subfalcately long-attenuate, subequilaterally acute-based, 3–3.5 × 12–14 cm., pinnately nerved nearly throughout, the nerves some 10 × 2, but with 2 or 4 from very near the base, long-ascending, green, chartaceous, narrowly revolute; petiole 5 mm. long, not winged; spikes opposite the leaves, 2 × 40 mm.; peduncle 5 mm. long; bracts small, rounded-subpeltate; berries globose; stigmas 3, minute, sessile.

HONDURAS: Wet forest, Lancetilla Valley near Tela, Dept. Atlántida, altitude 150 m., January 16, 1928, *Paul C. Standley* 54594 (Herb. Field Mus. No. 583,633, type). Also Nos. 52616, 52871, 53290, 56757, from the same region.

"Cordoncillo." Leaves often lustrous; spikes green or pale green.

Piper caliendriferum Trelease, sp. nov.

A somewhat nodose shrub; flowering internodes moderately slender and short, sparsely crisp-pubescent, darkening; leaves lance-ovate, acuminate, inequilaterally rounded at base or slightly cordulate, 4 × 9–5 × 10–13 cm., pinnately nerved from the lower half, the nerves 5 × 2, sparsely hirtellous toward the base above and more abundantly on the nerves beneath; petiole 15 + 2 mm. long, hirtellous, sheathing to the middle; spikes 5 × 60–80 mm., mucronate; peduncle 15 mm. long, from sparingly hirtellous to glabrescent; bracts subtriangular, subpeltate, large, long-ciliate; berries subglobose, glabrous; stigmas 3, linear, connate into a very short style.

MEXICO: Cerro de la Raya, Cuyamecalco, Oaxaca, alt. 2,800 m., *H. and C. Conzatti and T. C. Gómez* 2384 (Herb. Field Mus. No. 246,912, type).

Piper chichankanabanum Trelease, sp. nov.

A shrub (?), glabrous, nodose; leaves lance-oblong, acuminate, the little narrowed, acute base slightly inequilaterally unguiculate, 3.5 × 11–4.5 × 14

cm., 5- or 7-nerved, thin but becoming slightly bullate in age; petiole scarcely 5 mm. long; inflorescence unknown.

MEXICO: Chichankanab, Yucatan, *G. F. Gaumer* 23699 (Herb. Field Mus. No. 466,121, type).

PIPER COBANENSE Trelease, var. **sarculatum,** var. nov.

A suffrutescent weed 1–1.5 m. tall; flowering internodes slender and elongate, crisp-pubescent; leaves broadly ovate or round-ovate, acuminate, rounded at base or openly cordate, 12 × 15–16 cm., 9-nerved, the nerves hirtellous above and crisp-hirtellous beneath; petiole slender, variable (2–4 cm.) in length, crisp-pubescent, not winged; inflorescence unknown.

HONDURAS: In banana plantation, Quebrada Seca, Dept. Yoro, alt. 30 m., December, 1927, *Paul C. Standley* 53912 (Herb. Field Mus. No. 584,243, type).

Piper cordoncillo Trelease, sp. nov.

Flowering internodes rather slender and short, sparingly crisp-pubescent; leaves ovate, sometimes with nearly straight sides, blunt-acuminate, sometimes mucronulate, rounded or subtruncate at the base or abruptly deltoidly contracted into the petiole, moderately small (5–7 or 9 × 11–14 cm.), palmately 5-nerved, pubescent beneath and sparingly on the nerves above; petiole short (5–10 or 15 mm.), not winged, villous; spikes opposite the leaves, slender and moderately long (3–4 × 90 mm.); peduncle slender, short (about 5 mm.), hairy; rachis foveolate, glabrate; bracts subpeltate, rusty-ciliate; flowers sessile, perfect; stigmas 3–4, sessile, large; berries small, conical-ovoid, puberulent.

MEXICO: Mayito, Tabasco, in 1889, *J. Rovirosa* 423 (U. S. Nat. Herb. No. 798,394, type).

PIPER CORDONCILLO Trelease, var. **apazoteanum,** var nov.

Leaves more regularly ovate, the larger subpalmately nerved; leaves and stem much more densely pubescent.

MEXICO: Apazote, Campeche, *E. A. Goldman* 475 (U. S. Nat. Herb. No. 396,837, type).

Piper dedititium Trelease, sp. nov.

A shrub 2.5 m. tall; flowering internodes short and moderately stout, at most evanescently puberulent, becoming somewhat granular; leaves lance- or elliptic-oblong, acuminate, inequilaterally subacute at base, 5–6 × 12–14 cm., pinnately nerved from below the upper third, the nerves 4 × 2, rather glossy with the nerves velvety-puberulent beneath; petiole glabrous, about 10 + 3 mm. long, not winged; spikes opposite the leaves, 3–4 × 80–100 mm.; peduncle scarcely 10 mm. long, glabrous; bracts transversely subpeltate, ciliolate; flowers sessile, perfect; berries glabrous, brown, oblong, terete or slightly elongate with the rachis, concavely subtruncate; stigmas 3, small, sessile.

HONDURAS: Wet thicket, Quebrada Seca, Dept. Yoro, alt. 30 m., December, 1927, *Paul C. Standley* 53937 (Herb. Field Mus. No. 583,916, type).

Leaves dark green; spikes pale green.

Piper fallens Trelease, sp. nov.

A shrub 2.5 m. tall, dark-villous throughout; flowering internodes rather slender and short; leaves elliptic or lance-elliptic, sharp-acuminate, inequilaterally cordulate, 7–8 × 17–18 cm., pinnately nerved from below the middle, the nerves some 3 + 4; petiole about 3 + 2 mm. long; spikes opposite the leaves, 3 × 50 mm.; peduncle 10–15 mm. long; bracts triangular-subpeltate, the back white-fimbriate; berries rather large, papillate, truncate; stigmas 2, slender, on a short style.

HONDURAS: Wet forest, Lancetilla Valley near Tela, Dept. Atlántida, alt. 500 m., December 31, 1927, *Paul C. Standley* 53968 (Herb. Field Mus. No. 583,884, type). Also No. 56820, from the same region.

Piper fraguanum Trelease, sp. nov.

A shrub 2.5 m. tall; flowering internodes moderate, scabro-hispid becoming concolorously finely granular; leaves broadly elliptic, rather abruptly acuminate, nearly equilaterally rounded at base, 9–10 × 18–20 cm., pinnately nerved from the lower half, the nerves about 5 × 2, granular and lepidote above, scabrid beneath with upcurved-white-hispid nerves; petiole about 15 mm. long, hispid; spikes opposite the leaves, as yet young and small.

HONDURAS: Wet flat forest, La Fragua, Dept. Atlántida, alt. 20 m., February 7, 1928, *Paul C. Standley* 55730 (Herb. Field Mus. No. 581,536, type).

Piper Gaumeri Trelease, sp. nov.

A shrub 5 m. high, glabrous; flowering internodes moderately slender and short; leaves broadly elliptic, abruptly blunt-acuminate, mucronulate, abruptly subacute at the base, palmately 5-nerved or obscurely 7-nerved, small (5 × 8 cm.); petiole short (5 mm.); spikes opposite the leaves, slender but moderately long (3 or in fruit 4 by as much as 70 mm.); peduncle slender, short (10 mm.) but surpassing the petiole; bracts concave; flowers sessile, perfect; stigmas 3, sessile; berries distinct, small, oblong-ovoid.

MEXICO: Buena Vista Xbac, Yucatan, *G. F. Gaumer* 783 (U. S. Nat. Herb. No. 571,779, type).

Piper hispidiseptum Trelease, sp. nov.

A shrub 2–3 m. tall; flowering internodes moderate, scabro-hispid; leaves elliptic or subobovate-elliptic, more or less falcately acuminate, cordulate with one side shorter, 8 × 17–11 × 23 cm., pinnately nerved from the lower half, the nerves about 6 × 2, white-granular-scabrid and with hispid midrib above, the lower surface rather softly pubescent with stiffly hairy nerves; petiole some 15 + 5 mm. long, hispid; spikes opposite the leaves, 4 × 80 mm.; peduncle 15 mm. long, hispid; bracts roundish-subpeltate, ciliolate.

HONDURAS: Wet thicket, Lancetilla Valley near Tela, Dept. Atlántida, alt. 100 m., December 8, 1927, *Paul C. Standley* 52715 (Herb. Field Mus. No. 582,300, type). Also No. 55660 from the same locality.

"Cordoncillo." Spikes pale green.

Piper imperspicuibracteum Trelease, sp. nov.

A shrub 2–3 m. tall; flowering internodes rather slender and short, crisp-hirsute; leaves lanceolate, very gradually sharp-acuminate, inequilateral at base with the longer side rather rounded, 4–5 × 10–13 cm., pinnately nerved

from the lower half, the nerves about 4 + 5, granular-scabrous above, dark-punctulate beneath, with the nerves subappressed-hispid; petiole about 15 + 2 mm. long, upcurved-hirsute like the base of the midrib; spikes some 3 × 90–100 mm., straight; peduncle 5 mm. long, somewhat hirtellous; bracts rounded-subpeltate, rather dingy-margined.

HONDURAS: Wet thicket, near Tela, Dept. Atlántida, at sea level, January 19, 1928, *Paul C. Standley* 54770 (Herb. Field Mus. No. 583,364, type). Also No. 56602, from the same locality.

Leaves dark green; spikes pale green.

Piper indignum Trelease, sp. nov.

A compact nodose rusty-pubescent shrub 2 m. tall; flowering internodes rather stout and short, matted-hirsute; leaves ovate or lance-ovate, acute rather than acuminate, slightly inequilaterally obtuse at base, 4.5 × 9–5.5 × 10.5 or 7 × 13 cm., pinnately nerved from below the middle, the nerves 5 or 6 × 2, becoming rugulose, softly appressed-pubescent above and densely crisp-pubescent beneath; petiole 10–15 mm. long, soft-hairy; spikes opposite the leaves, as yet young and very small.

HONDURAS: Moist thicket, near Siguatepeque, Dept. Comayagua, alt. 1,100 m., February, 1928, *Paul C. Standley* 55990 (Herb. Field Mus. No. 582,044, type).

Piper lancetillanum Trelease, sp. nov.

A shrub 2–3 m. tall; flowering internodes moderately slender and elongate, hirsute; leaves subelliptic, acuminate, unequally somewhat cordulate, 7 × 16–10 × 22 cm., pinnately nerved from the lower half, the nerves about 6 × 2, sparsely short-hairy above, later granular and lepidote, appressed-hirsute beneath, especially on the nerves; petiole 10 or 15 + 2 or 3 mm. long, hispid-hirsute; spikes opposite the leaves, some 3 × 60 mm.; peduncle 5 mm. long, hispid; bracts rounded-subpeltate, ciliolate.

HONDURAS: Moist thicket, Lancetilla Valley near Tela, Dept. Atlántida, alt. 100 m., March 5, 1928, *Paul C. Standley* 56552 (Herb. Field Mus. No. 581,978, type). Also No. 53231, from the same locality.

"Cordoncillo." Spikes pale green.

Piper laterifissum Trelease, sp. nov.

A shrub 2–4.5 m. tall; flowering internodes rather stout and elongate, crisp-pubescent; leaves elliptic-subovate, subobtuse, cordate with lateral sinus, the rounded longer lobe much surpassing the petiole, 25 × 50 cm., subpinnately nerved below the upper fourth, the nerves 5 or 6 × 2, crisp-hairy beneath; petiole 4 cm. long, somewhat fleshy-warty or corky and crisp-pubescent, winged to the end; inflorescence unknown.

HONDURAS: Wet forest, Lancetilla Valley near Tela, Dept. Atlántida, alt. 300 m., December 31, 1927, *Paul C. Standley* 53943 (Herb. Field Mus. No. 584,143, type). Also, from the same locality, Nos. 55408, 54151, 53136.

Piper levilimbum Trelease, sp. nov.

A shrub 2–4 m. tall; flowering internodes rather slender and elongate, at most locally and evanescently slightly soft-hairy, somewhat pale-granular; leaves ovate, acuminate, equilaterally rounded or subtruncate at base or with

the base deltoid-acute or broadly cuneate, 7 × 14–14 × 17 or 12 × 20 cm., multiple-veined from the lower third or half, the nerves 3 (or obscurely 4) × 2, papery, submarginally ciliate beneath; petiole 2–5 cm. long, transiently pilose, winged at the base or on the more truncate-based leaves nearly to the blade; spikes opposite the leaves, 4 × 105 mm.; peduncle 10 mm. long, quickly glabrate; bracts rounded-subpeltate, ciliolate; flowers perfect, sessile; berries subtriquetrously obovoid, truncate; stigmas 3, minute, sessile.

HONDURAS: Wet forest, Lancetilla Valley near Tela, Dept. Atlántida, alt. 100 m., December 22, 1927, *Paul C. Standley* 53483 (Herb. Field Mus. No. 583,185, type). Also No. 55263, from the same locality. Triunfo, near Tela, in wet thicket, *Standley* 53839.

"Cordoncillo." Leaves dark-green; spikes green.

Piper micoense Trelease, sp. nov.

A shrub (?), nodose; flowering internodes moderately stout and short, crisply fine-hirsute, granular when subglabrescent; leaves lanceolate or subelliptic-lanceolate, sharply attenuate, inequilaterally cordulate, 3 × 9–5 × 12 cm., pinnately nerved from the lower half, the nerves some 5 + 6, rugose, silky-hirsute on both sides but becoming scabrous above from the bases of the fallen hairs; petiole some 5 + 3 mm. long, hirsute; spikes opposite the leaves, 3 × 80 mm.; peduncle slender, 5–8 mm. long, hirsute; bracts rounded-subpeltate, ciliate; flowers sessile, perfect; berries small, subcylindric, papillate; stigmas 3, sessile.

GUATEMALA: Sierra del Mico, between Los Amates and Izabal, *W. A. Kellerman* 6715 (Herb. Field Mus. No. 221,055, type).

Piper nonconformans Trelease, sp. nov.

A shrub 2 m. tall, nodose, of the aspect of *P. lanceaefolium*; flowering internodes short and relatively thick, densely yellow-hirsute; leaves lance-oblong, gradually sharp-acuminate, obtuse at base or semicordulate, 4–5 × 14–16 cm., pinnately nerved from below the middle, the nerves about 5 × 2, subrugose, finely pubescent above but quickly glabrescent and very rough-granular, lepidote, silky beneath and granular between the salient nerves and cross-veins; petiole about 5 mm. long, subhirsute, not winged; spikes opposite the leaves, somewhat curved, pale, as yet 2 × 50 mm.; peduncle scarcely 10 mm. long, subhirsute; bracts roundish-subpeltate, downy-ciliate; flowers sessile.

HONDURAS: In pine forest near Siguatepeque, Dept. Comayagua, alt. 1,100 m., February 1928, *Paul C. Standley* 55906 (Herb. Field Mus. No. 581,168, type).

Piper obsessum Trelease, sp. nov.

A shrub 2 m. high; flowering internodes slender and elongate, hispid-hirsute; leaves inequilaterally subovate, acuminate, the narrowed base rounded on the longer side, 6.5–7.5 × 13–16 cm., pinnately nerved from the lower half, the nerves about 6 × 5, thin, rather glossy, transiently short-pubescent becoming granular-roughened, somewhat subcrisp-pubescent beneath with upcurved-hirsute nerves; petiole 13 + 2 mm. long, upcurved-hirsute; spikes opposite the leaves, 3 × 50 mm.; peduncle 8 mm. long, scabro-hispid; bracts rounded-subpeltate, ciliolate.

HONDURAS: Wet thicket, Lancetilla Valley near Tela, Dept. Atlántida, alt. 100 m., January 22, 1928, *Paul C. Standley* 54925 (Herb. Field Mus. No. 584,233, type).

Spikes dull pale green.

Piper onerosum Trelease, sp. nov.

A shrub 2–3 m. tall, scarcely nodose; flowering internodes rather slender and moderately short, pale green, crisp-hirsute, finely papillate when glabrescent; leaves lance-elliptic, sharp-acuminate, inequilaterally cordulate, 7–10 × 16–18 cm., pinnately nerved from the lower half, the nerves 4 or 5 × 2, glossy dark green above, paler and crisp-pubescent beneath with hirsute nerves, the lower surface finally scabrid; petiole some 5 + 2 mm. long, hirsute, winged at base; spikes opposite the leaves, 3–4 × 55 mm., mucronate; peduncle 5–7 mm. long, hirtellous; bracts lunulate-subpeltate, ciliate; flowers sessile, perfect; berries globose, rusty-puberulent; stigmas 3, small, sessile in a depression.

HONDURAS: Edge of wooded swamp near Tela, Dept. Atlántida, at sea level, December 27, 1927 *Paul C. Standley* 53696 (Herb. Field Mus. No. 582,949, type). Also No. 56621, from the same locality. Near Progreso, Dept. Yoro, in wet thicket, alt. 30 m., *Standley* 55022. Lancetilla Valley near Tela, alt. 100 m., in wet thicket, *Standley* 52682.

"Cordoncillo." Stems pale green; leaves dark green; young spikes cream-colored, the older ones pale green.

Piper perspicuibracteum Trelease, sp. nov.

A shrub 2 m. tall; flowering internodes slender and moderately elongate, crisp-hirsute, granular-roughened; leaves lanceolate, gradually sharp- acuminate, inequilaterally rounded at base, 6 × 15 cm., pinnately nerved from the lower half with oblique cross-veins, the nerves about 4 + 5, granular-scabrous above and somewhat lepidote, dark-punctulate beneath with the nerves subappressed-hispid; petiole about 15 + 2 mm. long, upcurved-hirsute like the base of the midrib; spikes 3 × 120 mm., at first curved; peduncle 10 mm. long, granular; bracts round-subpeltate, with rather large, pale margin.

HONDURAS: Wet thicket, Lancetilla Valley near Tela, Dept. Atlántida, alt. 100 m., January 21, 1928, *Paul C. Standley* 54872 (Herb. Field Mus. No. 584,074, type).

"Cordoncillo." Spikes pale green.

Piper praeterlatum Trelease, sp. nov.

A shrub 2–3 m. tall, with the general characters of *P. aeruginosibaccum*, but the leaves lanceolate, falcately rather long-acuminate, somewhat crisp-pubescent beneath, and 6 × 15–8 × 20 cm.

HONDURAS: Wet forest, Lancetilla Valley, near Tela, Dept. Atlántida, alt. 100 m., January 11, 1928, *Paul C. Standley* 54337 (Herb. Field Mus. No. 583,571, type).

"Cordoncillo." Spikes pale green.

Piper prodigum Trelease, sp. nov.

A shrub 2 m. tall, rather nodose; flowering internodes moderate, somewhat hispid, finely granular when denuded; leaves lance-elliptic or becoming

broadly oblanceolate, sharp-acuminate, inequilaterally cordulate, 7–8 × 20 cm., pinnately nerved from the lower half, the nerves about 5 + 6, white-granular becoming lepidote above, the nerves upcurved-hispid-hirsute beneath; petiole about 10+2 mm. long, hispid; spikes opposite the leaves, 3 × 80 mm.; peduncle 10 mm. long, short-hispid; bracts rounded-subpeltate, ciliolate.

HONDURAS: Wet thicket, Lancetilla Valley near Tela, Dept. Atlántida, alt. 100 m., January 22, 1928, *Paul C. Standley* 54916 (Herb. Field Mus. No. 583,750, type).

"Cordoncillo." Spikes pale green.

Piper scabriseptum Trelease, sp. nov.

A shrub 2–3 m. tall, somewhat zigzag; flowering internodes moderately short and slender, matted-scabro-hispid, obscurely granular; leaves broadly elliptic or subovate, acuminate, inequilaterally slightly cordulate, 8–9 × 15–17 cm., pinnately nerved from the lower half, the nerves about 5 + 6, granular and lepidote with granular-roughened midrib above, the nerves beneath spreading hispid-hirsute; petiole 5 + 3 mm. long, hispid; spikes opposite the leaves, 3 × 60 mm.; peduncle 6 mm. long, short-hispid; bracts inconspicuous, rounded-subpeltate, ciliolate.

HONDURAS: Wet thicket, Lancetilla Valley near Tela, Dept. Atlántida, alt. 100 m., December 8, 1927, *Paul C. Standley* 52681 (Herb. Field Mus. No. 582,776, type).

"Cordoncillo." Spikes greenish white.

Piper speratum Trelease, sp. nov.

A shrub 2.5 m. tall; flowering internodes rather short and slender, drying angular, retrosely scabro-hispid; leaves obliquely elliptic, sharp-acuminate, rounded at base on the fuller side, 9–10 × 17–19 cm., pinnately nerved from the lower half, the nerves about 5 × 2, short-pubescent above becoming granular-roughened, scabrid beneath with upcurved-hispid nerves; petiole about 10 + 2 mm. long, hispid; spikes opposite the leaves, 3 × 90 mm.; peduncle 5 mm. long, scabro-hispid; bracts rounded-subpeltate, white-ciliolate.

HONDURAS: Wooded swamp, Tela, Dept. Atlántida, at sea level, January 27, 1928, *Paul C. Standley* 55184 (Herb. Field Mus. No. 583,272, type).

Spikes dull green or cream-colored.

Piper vexans Trelease, sp. nov.

A shrub 2.5 m. tall, slightly nodose; flowering internodes rather slender and short, hirsute, becoming glabrate and finely granular; leaves lanceolate, falcately sharp-acuminate, inequilaterally more or less cordulate, 5–6 × 14–16 cm., pinnately nerved from about the lower half, the nerves 4 or 5 × 2, glossy dark green above, crisp-pubescent and finally scabrid beneath; petiole some 5 + 2 mm. long, staring-hirsute, winged at base; spikes opposite the leaves, as yet 2 × 20 mm., scarcely mucronate, on short hirtellous peduncles; bracts subpeltate; flowers sessile, perfect.

HONDURAS: Wet thicket near Tela, Dept. Atlántida, at sea level, January 18, 1928, *Paul C. Standley* 54742 (Herb. Field Mus. No. 583,715, type).

Piper yoroanum Trelease, sp. nov.

A shrub 2 m. tall; flowering internodes moderate, crisp-subhirsute, pale-granular when denuded; leaves elliptic-subobovate, sharp-acuminate, the narrowed base inequilaterally rounded, 7–9 × 15–18 cm., pinnately nerved from the lower half, the nerves 5 or 6 × 2, minutely scabrid becoming granular and lepidote above with hispid nerves, the nerves beneath appressed-hirsute and the surface scabrid; petiole 5 + 5 to 15 + 5 mm. long, hispid; spikes opposite the leaves, as yet 3 × 50 mm.; peduncle 5 mm. long, hispid; bracts rounded-subpeltate, ciliolate.

HONDURAS: In wet thicket, Quebrada Seca, Dept. Yoro, alt. 30 m., December, 1927, *Paul C. Standley* 53889 (Herb. Field Mus. No. 583,866, type).

Spikes pale green.

ZOOLOGY.—*The development and generic position of* Sagrina (?) tessellata *H. B. Brady.*[1] JOSEPH A. CUSHMAN, Sharon, Massachusetts.

Brady described *Sagrina (?) tessellata* in the *Challenger Report* (Zoology **9**: 585. *pl. 76, f. 17–19.* 1884), from two or three specimens from Nares Harbor, Admirality Islands, 17 fathoms, and from Raine Island, Torres Strait, 155 fathoms. His original description reads as follows:

Test cylindrical, arcuate, slightly tapering; composed of a few (four or five) elongate, oval or subcylindrical segments, each a good deal larger than its predecessor, joined end to end. Surface areolated; the areae, which are of elongate, hexagonal form, disposed in regular, alternating, transverse lines. Aperture a central rounded orifice, with or without a sessile lip. Length 1/45th inch (0.57 mm.).

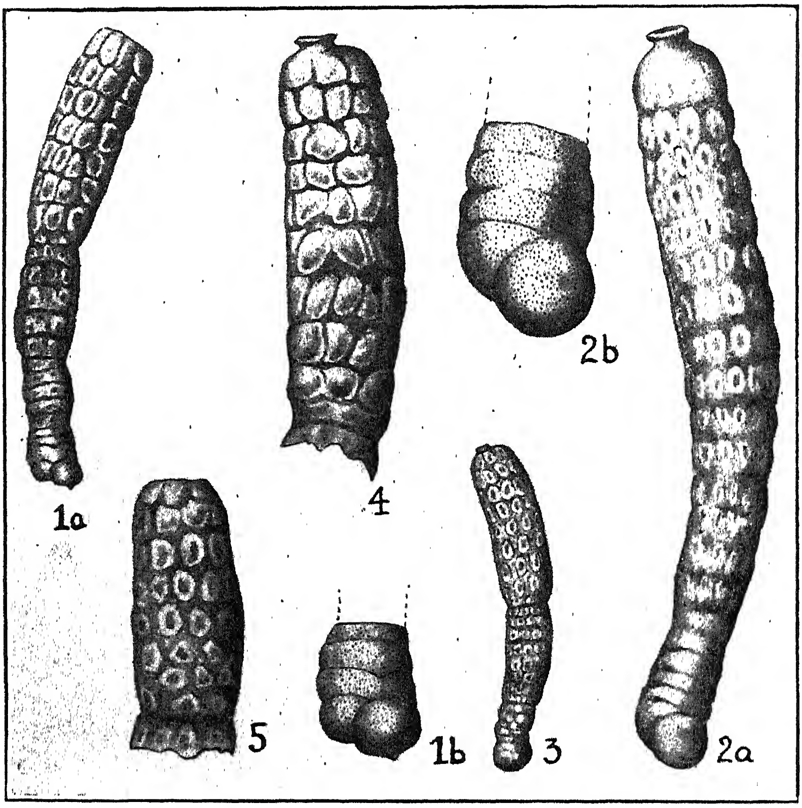
Other records for this species are given by Howchin from the Tertiary of Australia (Trans. Roy. Soc. So. Australia **12**: 11. *pl. 1, f. 7.* 1889), by Millett from the Malay Archipelago (Journ. Roy. Micr. Soc. **1903**: 273. *pl. 5, f. 16*), by Schubert from the Pliocene of the Bismarck Archipelago, a single 4-chambered specimen (Abhandl. k. k. geol. Reichs. **20** (4): 89. 1911), and by Heron-Allen and Earland from the Kerimba Archipelago off southeastern Africa (Trans. Zool. Soc. London **20**: 677. *pl. 51, f. 9.* 1915). These authors note that they "have records of it from many shallow gatherings in the Malay and Eastern Seas."

With this species is another, evidently closely related, named by Brady *Sagrina limbata* and studied farther by Millett, who found that the chambers are divided into chamberlets. He notes: "The division of the chambers by transverse septa is not a character of the genus *Sagrina,* and further researches will probably render it necessary

[1] Received July 11, 1929.

to constitute a new genus embracing the species *tessellata, limbata,* and probably *annulata.*"

In his paper in 1911, Schubert applied the name *Millettia* to Brady's species. This name having already been used, A. Silvestri (Riv. Ital. Pal. **1911**: 67, footnote) proposed the name *Schubertia* to take its place.



Figures 1–5.—*Schubertia tessellata* (H. B. Brady). 1, 2, Possibly microspheric specimens. 3, Megalospheric specimen (after Brady). 4, Apertural end. 5, Peculiarly tessellated surface. Magnifications: Fig. 1, × 120; 2, × 160; 1*a*, × 240; 2*a*, × 350; 3, × 75; 4, × 160; 5, × 160.

Two years ago, I examined the types in the Brady Collections in Cambridge and London, but the specimens were apparently megalospheric, and gave no clue to the early development. Lately I have found a series of specimens in Philippine material from Tacloban Bay among which are some, possibly microspheric, which give a clue to the early development. Two of these early series of chambers are figured

here (Figures 1, 2). They are apparently a generally biserial arrangement with indications of being slightly twisted. Such a development would place it in close relationship with *Siphogenerina* (*Sagrina* of numerous authors). In the megalospheric form figured by Brady, *Challenger*, pl. 76, fig. 17 (our figure 3), the early chambers are already apparently divided into chamberlets. In our specimens which show the early biserial stage, there are several chambers in a uniserial group which do not seem to be divided, and this character is only taken on after several simple ones are formed. As far as can be made out, the divisions of the chambers in *tessellata* are incomplete, but in some specimens they may be complete.

Our specimens show the apertural characters very well, and two of them are shown here. There is a definite neck with a spreading lip, as is characteristic of most species of *Siphogenerina*.

From a study of this series of specimens, it would seem that Silvestri's genus *Schubertia* may be used for *S. tessellata* (H. B. Brady) and *S. limbata* (H. B. Brady), but the structure of Brady's *Sagrina* (?) *annulata* is still in doubt. *Schubertia* is probably derived from *Siphogenerina* although it may be related to *Rectobolivina bifrons* which had numerous characters similar to those of *Schubertia limbata* particularly. The genus has existed in the Indo-Pacific region at least since the Early Tertiary, and today is widely distributed in that area from the coast of Africa to the Philippines and southward to Australia.

ZOOLOGY.—*Earthworms of North America.*[1] G. E. GATES, Judson College, Rangoon, Burma. (Communicated by MARY J. RATHBUN.)

Earthworms have received very little attention from our zoological investigators. Only one American, Frank Smith, has devoted any considerable amount of time to these animals, and his studies have been largely restricted to the species which occur in Illinois and contiguous states. It is to be expected that slimy creeping things which lack the beautiful colors of the moths and butterflies or the bizarre and curious forms of beetles and molluscs will not appeal to the instincts of the amateur collector, but an explanation for the neglect of such an important class of animals by professional zoologists is more difficult to find.

Several foreign zoologists have worked on American material, although, as a rule, they have been able to secure only small and quite

[1] Received July 22, 1929.

random collections. As a result of this situation any curious individual seeking information on the worms of this continent will find it necessary, in the absence of any comprehensive treatment of the subject, to wade through some ninety odd papers published in five languages in the scientific journals of eight different countries. In this mass of literature are records of occurrence in North America of 217 species of earthworms. Some few of the reports are mistaken, and a larger number of the generic and specific names are synonyms, but when these are eliminated enough remain to demonstrate that beneath the slimy, "repulsive," exterior is concealed a considerable variety of structure.

Structural variations, although of some interest, *per se*, become more significant when it is possible to distinguish primary from secondary characteristics and to arrange the various species thereby into a phylogenetic or evolutionary sequence. This has been done with some degree of success for earthworms, including many of the most characteristic genera of our own region.

Furthermore, although the number of species recorded from the area under consideration may seem at first thought to be rather large, it is probably but a fraction of the number of interesting forms that yet remain to be discovered. The records of distribution indicate how fragmentary our present knowledge is and at the same time suggest many opportunities for further investigation.

In the ensuing discussion earthworm is used to refer to any megadrilous oligochaete irrespective of terrestrial or aquatic habitat and North America is regarded as comprising not only all of the land mass north of the Panama Canal but also the islands of the West Indies.

The Acanthodrilinae

The ancestral type from which it is customary to trace many of the various lines of earthworm descent is known as the "Acanthodrilin Urform." This has the following characteristics:—

1. Paired testes and deferent duct funnels naked in segments ten and eleven.
2. The male ducts (vasa deferentia) on each side unite behind the second pair of funnels, pass backwards, and open to the exterior by a male pore on each side of segment eighteen.
3. Glands of unknown function called prostates, paired, tubular, and with an unbranched central canal open to the exterior on segments seventeen and nineteen.
4. Setae (solid, needle-shaped, chitinous bars embedded in epidermal sacs) four pairs per segment.

5. Nephridia (coiled tubular excretory structures) large, one pair in each segment. Loosely called meganephridia.
6. A single oesophageal gizzard located anteriorly in segments five, six, or seven.

Earthworms with the characteristics just enumerated are included in *Acanthodrilus*, a genus represented in our region by nine indigenous species. Six occur in Guatemala, one in Mexico, one in Cuba. One the distribution of which is either greater than the others or perhaps merely better known extends from Mexico to Guatemala. Elsewhere the genus is indigenous in South America, South Africa, Australia, New Zealand, and some of the Antarctic islands.

Microscolex was derived from *Acanthodrilus* by the disappearance of the posterior pair of prostates and the dislocation forward of the male pores to open to the exterior, together with the ducts of the anterior pair of prostates, on segment seventeen. This development of the male organs is known as the microscolecine reduction from the genus in which it was first observed, but it has appeared in other families as well as in the Acanthodrilinae. Two species of *Microscolex* have been found in various places on this continent but both are peregrine, i.e., widely distributed either by their own or by human effort and hence not of any zoogeographical significance. One of these species is the remarkable luminescent form *M. phosphoreus*.

In another genus of the family the anterior instead of the posterior prostates disappeared and the posterior pair of prostatic pores moved forward to open on segment eighteen near the apertures of the vasa deferentia. This genus, *Diplotrema*, is found today only in Queensland and New Caledonia, but from it was derived a large and important family, the Megascolecinae.

The Megascolecinae

The first genus of this family, *Plutellus*, arose from the Acanthodrilin *Diplotrema* by the fusion of the male pores with the prostatic pores on segment eighteen. This condition of the male apparatus remains characteristic throughout the whole family. The genus *Plutellus* was founded by Perrier in 1873 for a worm said to have been collected in Pennsylvania, but the species, *P. heteroporus*, has never again been found, in spite of the plea of Benham for the collection of further specimens. Six other American species have since been found, four in California, one in Guatemala, and one in Canada. This last, *P. perrieri*, from Queen Charlotte Island, has been collected but once, and is the only species of earthworm known to be endemic in Canadian territory.

Megascolides, the next genus in the Megascolecin line of descent, was derived from *Plutellus* by a "breaking up" of the nephridia, i.e., instead of one pair of "meganephridia" in each segment there may be three or four "micronephridia" on each side, all of the same size, or one on each side larger than the others. The single American species of this genus was found at Pullman, Washington, and described by Smith in a preliminary note in 1897. Although the worm is fairly large, 180–190 millimeters long with a diameter of six to seven millimeters, and in spite of the fact that the species was said to be very abundant in the region in which it was found, no further information has yet been made available. This may possibly be due to the fact that the burrows of this worm extend to a depth of over fifteen feet. Smith's specimens were obtained from a road cutting. Species of *Megascolides* are found elsewhere only in India, Australia, and Tasmania.

The next step in the evolution of the family was the branching of the central canal of the prostate. Worms with this development belong to the genus *Notoscolex* and occur in India, Australia, and New Zealand. From *Notoscolex* was derived *Megascolex* by an increase in the number of setae, at first to six or eight pairs, and then to a much larger number arranged in a more or less closed ring running completely around each segment. *Megascolex* is also limited to India, Australia, and New Zealand. Megascolecin evolution reached its culmination in the very large genus *Pheretima*, derived from *Megascolex* by a still greater increase in the number of setae per segment and the inclosure of the testes and male funnels within testis sacs. The genus is represented in North America by more than half a dozen species all of which are world wanderers. The peregrine forms of the genus are known to have been imported in dirt around the roots of plants into places far from their original habitat. This doubtless explains the finding of *P. hawayana* in the greenhouses in Evanston, Ill., and *P. heterochaeta* in greenhouses in Urbana, Ill. The occurrence of the latter species in fields of several Gulf States apparently indicates that accidental importation may result in permanent colonization.

The Diplocardiinae

A family much more characteristically American arose from the "Original Acanthodrilin" through the doubling of the gizzard, the initial genus, *Diplocardia*, having the Acanthodrilin arrangement of the male reproductive organs, lumbricin setae (four pairs per segment),

meganephridia, and two gizzards. This genus is remarkable for the variation in position of the male pores, these external male orifices being present typically on segment eighteen in only one species, *D. koebelei* from Morelos, Mexico. The male pores are on segment nineteen in *D. floridana* (Monticello, Fla.), *D. mississippiensis* (McNeill, Miss.), *D. michaelseni* and *D. udei* (Raleigh, N. C.), *D. longa* (Pulaski County, Ga.), *D. riparia* (Ill. and Ind.), *D. communis* (Ill.), *D. singularis* (Ill., Ind., and Raleigh), and *D. eiseni* (Fla., and Savannah, Ga.); on segment twenty in *D. verrucosa* (Ill., and Omaha, Neb.); and on segment twenty-one in *D. keyesi* (lower California and Chillicothe, Texas). As is evident from the preceding list which gives complete records of known distribution except for those species which have been found in two or more localities in a single state, much remains to be done in the way of working out the distribution of these typically American forms.

Zapotecia was derived from *Diplocardia* by an increase in the number of gizzards to three. Two species have been described, one from Mexico, the other from Haiti.

Trigaster was also derived from *Diplocardia* but by an increase in the number of nephridia per segment. Two species are known, one in Mexico, and one with three varieties in the little island of St. Thomas.

The culmination of the Diplocardin line of descent, so far as North America is concerned is *Dichogaster*, derived from *Trigaster* by the development of three pairs of calciferous glands in segments fifteen, sixteen, and seventeen. Three of the twenty-five species found in our region are either peregrine or of uncertain habitat, the other twenty-two have been obtained from Mexico (6), Costa Rica (6), Guatemala (2), Jamaica (4), Haiti (3), and St. Thomas (1). A portion of tropical Africa is characterized by the presence of a large number of species of endemic Dichogasters.

THE OCNERODRILINAE

Another line of descent from the Acanthodrilinae was initiated by the development of paired oesophageal sacs in segment nine. *Kerria*, the most primitive genus of the family is represented in our fauna by three species, two in Lower California, and one in the island of St. Thomas. Numerous other species are found in South America.

Ocnerodrilus was derived from *Kerria* by the microscolecin reduction of the posterior male organs. Occasionally there are two pairs of prostates but when the second pair is present the prostatic glands

always open to the exterior on segment eighteen. *O. occidentalis* is the only representative of the genus in the United States but is peregrine and circummundane in the tropics. Sixteen endemic species are scattered through the southern portion of North America as follows: Mexico (7), Guatemala (7), Costa Rica (11), Cuba and St. Thomas (1).

Two other genera of the family come into our region with a single species each, *Gordiodrilus* with *G. dominicensis* in Dominica, and *Nematogenia* with *N. josephinae* in Costa Rica. Endemic species of both genera are found in Africa. The Ocnerodrilinae gave rise, apparently in Africa to another family, the Eudrilinae. A single species, *Eudrilus eugeniae*, has escaped from that continent and become widely distributed in the tropics, occurring in our continent in Panama and the West Indies.

Other Families

According to Michaelsen the Acanthodrilinae evolved from the Phreoryctinae, a group of small freshwater worms (Microdrili-Limicolae). Another line of descent from the Phreoryctinae resulted in the development of the other families which occur in our continent. The initial group in this second line of descent from the freshwater worms was the Glossoscolecinae which are characteristically South American but which come into our region with two endemic species of *Andiodrilus* in Costa Rica and two species of *Pontoscolex*. Other species of *Andiodrilus* are endemic in South America. Only two species of *Pontoscolex* are known; one, *P. corethrurus* which has been collected in Mexico and several Central American countries as well as in various islands of the West Indies, is pretty well scattered around the world in the tropics. A second species appears to be endemic in Guatemala. From some portion of the Glossoscolecinae there arose the Microchaetinae. This group of earthworms characterizes Africa except for a single genus in South America, *Drilocrius*, which intrudes into Costa Rica with one species. Another development from the Glossoscolecinae is the family Sparganophilinae of which only two species are known. One of these, *S. eiseni*, is widely distributed in the area from Guatemala to Michigan, but the other, *S. tamesis*, has been found only in the Thames River near Oxford, England, to which place it was presumably carried by man. The family is considered to be purely North American.

From the Microchaetinae by way of a very small, purely European

family, the Criodrilinae, Michaelsen derives the Lumbricinae, with endemic species in both Europe and the United States. From North America there have been collected 26 species of which eighteen are peregrine, presumably immigrants from Europe. Among this number are such well known forms as the nightwalker, *Lumbricus terrestris*, the dungworm, *Eisenia foetida,* and the very common *Helodrilus caliginosus*. All of the peregrine species have been collected more or less widely on this continent. Much less well known are the endemic forms. These include *Eisenia lönnbergi* described by Michaelsen who had specimens from Raleigh and Savannah, *E. carolinensis* founded by the same author for a single worm obtained from the dirt around the roots of a plant imported in the Botanical Gardens of Hamburg, Germany, from Fayetteville, N. C., and several species of *Bimastus*. There are no further records of the occurrence of *Eisenia* but the distribution of some of the *Bimastus* forms has been worked out more thoroughly. *B. palustris* has been collected in Pennsylvania, New Jersey, and in Raleigh, N. C.; *B. giesleri* in Savannah, Ga., Florida, Ohio, Illinois, Kansas, and Texas; *B. zeteki* in the Susquehanna River, N. Y., and in Douglas Lake, Mich., *B. tumidus* has been collected only in Mt. Lebanon, N. Y., *B. longicinctus* has been found only in Urbana, Ill. *B. welchi* was erected for a single specimen obtained in Manhattan, Kansas.

Zoogeographical Relationships

The occurrence of endemic species of the same genus in areas as widely separated as North America, Africa, India, Australia and New Zealand has of course attracted much attention from students of the earthworms. Interest in these problems has been increased by the demonstration that many of the purely terrestrial forms are limited in their movements by numerous natural barriers such as deserts, mountain-ranges and bodies of salt water. In the past it has been customary to regard the occurrence of these generically similar endemic species in widely separated areas as evidence for some sort of geographical connection between the areas concerned, in geological time more or less remote. Michaelsen even went so far as to maintain that in the Oligochaeta we have a group "which is capable of yielding results for paleogeography second to those of no other group in importance and certainty." The geographical relationships and their explanations so far as our own continent is concerned may be briefly summarized as follows.

Acanthodrilus is common to South America, South Africa, Australia and New Zealand. This distribution is taken as evidence for a former connection of the areas concerned either by a continuous Antarctic continent or by means of bridges represented today only by islands, the vestigial mountain tops of ranges that have sunk with the rest of the bridge beneath the sea. In a northward direction *Acanthodrilus* has penetrated into Central America presumably passing over the contemporary bridge connecting the two Americas, the Isthmus of Panama.

Plutellus and *Megascolides* originated in Australia or somewhere in the Australasian region and are supposed to have migrated into North America from Asia over a Behring bridge across the north Pacific.

In contrast to the Megascolecin forms, *Diplocardia* is thought to have originated in Mexico where it gave rise to forms that migrated northwards into the United States. Stephenson has described a species of *Diplocardia* from central India which, he assumes, reached that locality by migrating from North America over the Behring bridge in an opposite direction to that taken by the Megascolecin forms. Derivative genera such as *Dichogaster* are presumed to have wandered southwards and westwards to what later became the islands of the West Indies. The occurrence of numerous indigenous Diplocardin forms in Africa is regarded as evidence for a transatlantic bridge connecting Africa and Central America through the region of the West Indies. The Ocnerodrilinae furnish additional evidence for this Atlantic bridge.

Finally, the occurrence of endemic species of the Lumbricinae in South Europe and the United States is considered to be evidence for another bridge, probably in the North Atlantic region, connecting Europe and North America. The absence of endemic species of the family in the northern portions of both continents at the present time is explained to be the result of their extinction by glacial sheets of ice which covered these regions after the migration had taken place.

Bridges as explanations of earthworm distribution raise many difficulties, sometimes more than they obviate. Michaelsen has lately tried to avoid some of these difficulties by adopting Wegener's hypothesis of separation and eventual wide-apart displacement of continents from a single gigantic land mass. A diagram in Michaelsen's paper shows the southern portion of South America (*Acanthodrilus* region) in contact with the southern portion of Africa, the

Diplocardia region of Central America continuous with a central African *Dichogaster* belt, and the endemic *Eisenia* region of the United States in contact with a corresponding area in southern Europe. According to this theory, the worms concerned migrated from one region to another while the land masses were still in contact, then later on a separation and pulling apart of the continents brought about the formation of the deep ocean basins between.

More recently still Stephenson has pointed out certain indications tending to show that the earthworms are a relatively recent group, much more recent in fact than the gigantic land mass of Wegener or many of the bridges invoked to explain the facts of their distribution. In place of bridges Stephenson offers as his contributions to a solution of the problem transportation of cocoons in mud on the feet of birds, transference of adult forms in natural rafts, and polyphyletic origin of some of the genera concerned, i.e., the origin of a genus independently from different species of the same ancestral genus or even from two or more different genera.

The cocoons of earthworms, however, are usually deposited, by the purely terrestrial forms at a depth where there is very little likelihood of their becoming entangled in mud on the feet of birds, and furthermore, being rather slippery may be expected to offer considerable difficulties in the way of long distance transportation by birds. Raft transference of adult worms does not seem to be of much value in explaining the passage of worms between continents widely separated by permanently deep ocean basins. Finally it does not seem too much to expect at the present, that further study will enable the separation of mixed groups into genera of purely monophyletic origin, for the vast majority of our present species are based upon characteristics visible in dissection without adequate knowledge of the microscopical anatomy. Little or nothing at all is known of the oligochaete fauna of many large and very important areas and the thorough exploration of these regions together with detailed microscopic studies may be expected to assist materially in the solving of problems of the evolution and distribution of the earthworms.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

BIOLOGICAL SOCIETY

733D MEETING

The 733d meeting of the Biological Society was held in the new assembly hall of the Cosmos Club March 23, 1929, at 8.10 p.m., with President GOLDMAN in the chair and 120 persons present. The minutes of the preceding meeting were read and approved.

The chairman announced that the new list of birds of the District of Columbia, by Miss M. T. COOKE, is just off the press.

VERNON BAILEY stated that the deer situation in Pennsylvania is not yet cleared up. In one county 231 dead fawns of the previous year were counted which had died from starvation due to overstocking and consequent exhaustion of the food within the reach of young animals.

E. P. WALKER exhibited a new binder for pamphlets, consisting of a stout cover with flexible steel rods permitting the ready insertion or removal of the contents.

The regular programme was as follow :

PAUL B. JOHNSON: *The pupil of the eye* (illustrated).—A summary based on published accounts and on the author's observations. *Amphibia:* vertical (= V), horizontal (= H), triangular and rhomboid—Gadow, Cambridge Nat. Hist. *Reptiles:* V and R (= round)—loc. cit. *Fishes:* (few personal observations). H oval pyriform pointed foward, V, R; divided pupil in Anableps—Boulenger, Camb. N. Hist. *Birds:* observed in National Zoological Park; generally R; black skimmer contracted to V (A. Wetmore); so some parrots, a macaw. *Mammals:* National Zoological Park; also citations from G. L. Johnson, Phil. Trans. Roy. Soc. v. 194 B (= GLJ). *Round:* echidna; marsupials (kangaroos H?—PBJ); edentates; chiroptera; insectivores; rodents except V and H below; tapir (H—PBJ), rhinoceros, elephant; Ursidae; Procyonidae except coati (H); Mustelidae; wolves, jackals, coyotes; large cats (see V below); Lemurinae (see V below); Simiae. *Vertical lentiform:* viscacha (H—GLJ); foxes (see below); Hyaenidae; Viverrinae; small cats, but including lynxes, clouded leopard, ocelot, serval (last two R—GLJ); seals and sea lions (GLJ; at times, PBJ; see below); galago, potto. *Vertical pyriform:* pointed below; icticyon (cf. lycaon below). *Slightly V oval* (*GLJ*): spotted cavy (R—PBJ), capybara, coypu; foxes; lycaon, raccon-like dog; lemurs, galagos; (occasionally in African leopard—PBJ). *Horizontal:* viscacha (V—PBJ), marmots, a few Sciuridae (GLJ); dipodomys;most ungulates: large or small oval, or long margins straight or concave; only upper margin concave, contracted to slit, convex down, musk ox; margins with sooty granules or fringes, some equids and ruminants; interlocking processes, camel, llama (GLJ): protrusile appendage, hyrax (GLJ); Herpestinae, oblong oval; coati, pyriform pointed laterally; Cetacea and Sirenia, oval (GLJ et al.). Seals and sealions: large R, night, contracted to V oval, lentiform, small central R, minute V and H slits; cruciform closure? (See J. Murie, Trans. Zool. Soc., v. 7). All mammals at night: dilatation varies; many V and H preserve type (small flashlight used). Study under controlled conditions urged. (*Author's abstract.*)

E. W. BRANDES: *Sugar plant hunting by aeroplane in New Guinea* (illustrated).—The speaker showed a seven reel motion picture taken in the territories of Papua and New Guinea and Dutch New Guinea. This picture was taken by himself and R. K. Peck, airplane pilot, during an expedition to the Island of New Guinea, sponsored by the United States Department of Agriculture, for the purpose of collecting varieties of sugar cane resistant to mosaic and other diseases of the cane plant. The expedition left this country in April, 1928, and returned in October bringing 176 varieties of sugar cane collected in all three of the political divisions of the Island of New Guinea, from the coastal plains to the high mountains of the interior. The collection of varieties is now growing in quarantine at Arlington Farm and will be sent to the commercial cane areas of the south some time this fall for testing for adaptability in this country. The motion picture consisted of a pictograph record of travels and experiences in New Guinea where the party encountered tribes of head-hunting savages, cannibals and pigmies. Much of the territory covered was unmapped and the party added considerably to the knowledge of the geography of the region, discovering many unknown lakes and rivers in the lake plain of western Papua. Transportation of the scientific party in New Guinea was almost exclusively by seaplane working out from base camps established on the Fly, Strickland and Sepik rivers. About 10,000 miles was covered by this means and contacts made with tribes of natives not heretofore seen by white men. The large collection of ethnological and natural history specimens obtained has been turned over to the Smithsonian Institution. (*Author's abstract.*)

734TH MEETING

The 734th meeting was held in the new assembly hall of the Cosmos Club April 6, 1929, at 8.10 p.m., with President GOLDMAN in the chair and 75 persons present. New member elected: C. F. W. MUESEBECK.

R. M. LIBBY announced the arrival of purple martins on March 23.

C. W. STILES: *The zoo-parasitic diseases of non-human primates in reference to diseases of man* (illustrated).—A considerable number of parasites of non-human primates are congeneric with parasites of man, and in a number of instances the non-human primate infection is conspecific with that of man. For instance, *Endamoeba histolytica* (of amoebic dysentery), *Necator americanus* (the American hookworm), and a number of other parasites are reported for both monkeys and for human beings; the higher apes have malarial parasites which are very similar to those of man, but their specific identity is not at present generally accepted; several different monkeys are known to be favorable hosts for yellow fever and for various species of *Trypanosoma* and *Spirochaetacea* which are reported for man. The question of the potentiality of menageries and museums in the spread of disease from primates to man represents a comparatively new subject and the administrative side of the question will depend entirely upon the amount of good which might be accomplished with a given amount of money which might be spent. Some phases of the subject are undoubtedly more academic than practical, but other phases certainly border on the practical. (*Author's abstract.*)

C. F. SWINGLE: *Botanical exploration in Madagascar* (illustrated).—The speaker, in company with Dr. HENRI HUMBERT, Professor of Botany in the University of Algiers, left Marseilles June 7, 1928, for Madagascar, on a plant exploration expedition sponsored by the University of Algiers, the Arnold

Arboretum of Harvard University, and the United States Department of Agriculture. This was Dr. HUMBERT's third trip to Madagascar, but it was the first time an American botanist had ever visited France's "Great African Island." The party covered a large part of Madagascar but most time was spent in the relatively inaccessible and little known southwest, a region characterized by an extensive and very peculiar native flora, in spite of the arid nature of the country. In particular, tree Euphorbias, some 30 or 40 feet high, serve to make this region unique.

The expedition traveled partly by auto, partly by boat, but in the southwest the *filanzana*, a special type of sedan chair, was employed.

The speaker reached Washington in November with the living plant material, while Dr. HUMBERT remained in Madagascar until February, then going into Tanganyika and Kenya to compare the flora there with that of Madagascar.

The party collected some 3000 herbarium numbers, and a considerable quantity of living plant material. The real prize consisted of living specimens of *Euphorbia intisy*, a plant known to yield a rubber of very high quality, but one practically exterminated because of the ruthless collecting methods employed by the natives.

A more complete account of the trip is to appear shortly in the National Geographic Magazine. [appeared August 1st 1929] (*Author's abstract.*)

735TH MEETING

The 735th meeting was held in the new assembly hall of the Cosmos Club April 20, 1928, at 8.10 p.m., with President GOLDMAN in the chair and 90 persons present. New members elected: G. G. BECKER, RALPH ELLIS, JR. (life member), and E. H. TAYLOR.

J. M. HOLZWORTH: *The brown and grizzly bears of Alaska* (illustrated).—The speaker exhibited several reels of motion pictures of bears of two or more species, many of which were taken at very close range. They illustrated the fishing and other habits of the bears and their attitude towards man. In general they are inoffensive.—Discussed by C. H. MERRIAM, who commented on the abundance and remarkable tameness of the bears, and contrasted these conditions with those found by SHELDON in his work about Mt. McKinley where bears were very scarce and shy.

SPECIAL MEETING

A special meeting of the Biological Society was held May 11, 1929, at 8 p.m., in the auditorium of the National Museum, with President GOLDMAN in the chair and 140 persons present. The program was as follows:

R. G. CANTI, Cambridge, England: *Living tissue cells grown in vitro* (illustrated).—A three reel moving picture was exhibited and explained by Professor F. A. VARRELMAN, which showed cells of cancer and the heart of a chicken in their life processes of growth, division, and locomotion, and exhibited the amoeboid and ciliate tendencies of cells when grown by themselves in culture media.

S. F. BLAKE, *Recording Secretary.*

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BOTANY.—*Botanical notes on, and descriptions of, new and old species of Venezuelan plants.—II. Old and new species of Euphorbiaceae.*[1]

H. Pittier, Caracas, Venezuela.

Fragariopsis Paxii Pittier, sp. nov.

Scandens, caulibus teretibus, gracilibus, parce pilosulis; foliis membranaceis, palmatinerviis, petiolatis, petiolis mediocribus, pubescentibus, apice bistipellatis; laminis ovato-lanceolatis, basi subtruncatis abrupte cuneatis conspicue biglandulosis, apice tenuiter cuspidatis, marginibus dentato-sinuatis, costa venisque primariis supra subtusque plus minusve pubescentibus; floribus monoicis, inflorescentiis bisexualibus basi florem foeminaei unicum gerentibus, caeterum maribus; pedunculis rhachidibusque cano-pubescentibus; bracteolis lanceolato-acutis pubescentibus; floribus maribus numerosis, racemulosis, pedicellatis; pedicellis modice-longis, medio articulatis et minutissime bracteolatis, parce puberulis; alabastris minutissime puberulis pubescentibusve; calyce 4-lobulato, lobulis ovato-lanceolatis, acutis, glabris; staminibus 8–16, purpureis; filamentis nullis; antheris bilobulatis, lobulis discretis, rimosis; floribus foemineis maribus majoribus, longe pedicellatis pedicello medio articulato et bracteolato; sepalis 4, triangulari-acuminatis apice puberulis; ovario 4-loculari, depresso-globoso, extus pubescente; columna stylari elongata, crassa, purpurea, basi plus minusve puberula, apice stigmatibus 4, magnis, flavis coronata. Capsula deest.

Petioli 3 cm. longi; laminae 8.5–10 cm. longae, 3.5–4.5 cm. latae. Pedunculi 0.5–1.5 cm. longi; pedicellum floris maris 1–1.5 mm., foeminei 2–3 mm. longum. Sepala masc. 1.5 mm., foem. circa 2 mm. longa. Columna stylaris 5–6 mm. longa.

Federal District: Loma de En Medio, valley of Puerto La Cruz, 1000 m., in forest; flowers September 4, 1918 (*Pittier* 8109, type).

This is a very interesting addition to the flora of Venezuela, since the plant belongs without any possible doubt to a genus hitherto considered as monotypic and known only from South Brazil. The species is named in honor of Dr. F. Pax, the well known monographer of the Euphorbiaceae.

[1] The first contribution under this title appeared in This Journal, 19: 175–186. 1929.
Received August 16, 1929.

Manihot remotiloba Pittier, sp. nov.

Arborescens, glaberrima, ramis brevibus, crassis; stipulis parvis, triangulari-acutis; foliis longissime petiolatis, ambitu reniformi, petiolo basi crasso apicem versus sensim attenuato, laminis amplis, supra viridis subtus glaucescentibus, fere usque ad basin 5-lobulatis, lobis remotis, angustis, lanceolatis, acuminatis, penninerviis, costa nervisque subtus prominulis, marginibus integris sinuatisve; inflorescentiis terminalibus, modice pedunculatis foliis multo brevioribus; floribus viridi-flavescentibus, masculis brevissime pedicellatis, bracteatis, bracteis oblongis obtusiusculis apice plus minusve denticulatis; alabastris globosis; calyce subcampanulato, lobulis ovatis, obtusis, extus glabris, intus pubescentibus; petalis nullis, disci glandulis liberis; staminibus 8, liberis, filamentis exterioribus antheris aequantibus, interioribus brevissimis, floribus foemineis masculis duplo longioribus; disci glandulis coalitis; ovario globoso, glabro; stigmatibus subsessilibus, purpureis; capsula magna, lignosa, globosa, tantum depressa; seminibus laevibus, griseis, ovoideis, depressis, ecarunculatis.

Arbor 3–4 m. alta. Petioli 10–22, plerumque circa 20 cm. longi; laminae 10 cm. longae, 16–18 cm. latae, lobulis 7.5–10 cm. longis, 3–4.5 cm. latis, externis brevioribus. Flores foeminei 10.5 mm. longi, pedicellis circa 7 mm.; flores masculi duplo breviori; filamenta staminum exteriorum circa 4 mm. longa. Capsula 1.3 cm. longa, 2 cm. lata; semina 9–10 mm. longa, 6–8.5 mm. lata, 4–5 mm. crassa.

YARACUY: In thorn bushes between Yaritagua and Urachiche, flowers and fruits April 10, 1925 (*Pittier* 11761, type).

Belongs to Sect. *Parvibracteatae,* Subsect. *Graciles* and takes place between *Manihot Catingae* Ule and *M. Johannis* Pax.

Manihot meridensis Pittier, sp. nov.

Frutex glaberrima, stipulis minimis caducis, foliis petiolatis, petiolo modice longo, laminis subreniformibus, basi aperte cordatis, fere usque ad basin 3-lobulatis, lobulis ovato-lanceolatis, acuminatis, medio integro, lateralibus plus minusve sinuatis basi extus saepissime semi auriculatis, auricula oblonga, sinuata; inflorescentiis axillaribus, subspicatis; bracteis minutissimis, caducis; floribus longe pedicellatis, basalibus 2 foemineis demum masculis; calyce floris maris globoso, extus glabro, intus pubescente, lobulis oblongis, obtusis; staminibus 10 utrinque hirtellis; filamentis 4 exterioribus brevibus, interioribus subaequantibus; sepalis floris foeminei fere liberis, maris triplo longioribus, ovato-lanceolatis; disci glandulis adhaerentibus, apice plus minusve reflexis; ovario globoso; stylis cohaerentibus; stigmatibus purpureis.

Petioli 2.5–4 cm. longi; laminae 4–5 cm. longae, 5.5–10 cm. latae; lobuli 3.5–4.5 cm. longi, 1.5–2.2 cm. lati, exteriori breviores. Inflorescentiae 7–9 cm. longae; pedunculi 3–4.5 cm. longi, pedicelli 0.5–1 cm. longi, maris foemineis dimidio breviores. Flores masculi 6–7 mm., foeminei 11–13 mm. longa; filamenta 2–4.5 mm. longa; antherae 4 mm. longae.

MÉRIDA: Lagunillas, 700 m., flowers March 13, 1922 (*A. Jahn* 1000, type).

This low shrub belongs to section *Heterophyllae* and is remarkable for its large female flowers and its 3–lobate leaves, with the exterior lobes almost always auriculate on the outer side. It probably should be placed in the group of the *Variifoliae,* not represented heretofore in northern South America.

Mabea microcarpa Pittier, sp. nov.

Arbor parva, coma expansa, rotundata, ramulis gracilibus, virgatis, cortice glaberrimo obscure brunneo tectis; foliis coriaceis, in sicco nigrescentibus, petiolatis, petiolis brevibus, canaliculatis, glabris, laminis ovalibus, basi rotundatis, apice abrupte cuspidato-acuminatis, minutissime mucronulatis, marginibus serrulatis, supra sublucidis, obscure venosis, subtus pallidioribus costa venisque secundariis circa 12 prominentibus, venulis prominulis; inflorescentiis terminalibus, anguste paniculatis, pedunculatis, pedunculis bifidis ramulosisve, ramulisque copiose bracteosis; bracteis lineari-acuminatis, glabris vel leviter puberulis; ramulis masculis laxis, elongatis, umbellulatim 1–3-floris, prope basin biglanduliferis, rhachi pedicellisque minutissime rufo-puberulis, oblongis; glandulis floris maris validis, oblongis, juxtapositis nigrescentibus; pedicellis gracillimis; bracteola ovato-acuta, puberula, integra vel minutissime remoto-denticulata, eglandulosa, sepalis triangularibus, acutis, puberulis; staminibus 22–24; bracteis floris foeminei 3, linearibus, puberulis, lateralibus brevioribus; pedicello puberulo, basi glandulis 2, parvis, rotundatis suffultis; calyce puberulo, sepalis exterioribus 3 interioribus minoribus, ovato-lanceolatis, acutissimis; ovario subgloboso, columna stylari elongata et stylorum parte libera columna breviora omnino rufo-tomentellis; capsula parva, globosa, basi apiceque plus minusve truncata, profunde sulcata, parce ochraceo-tomentella, calyce persistente suffulta; semina obovoidea, leviter compressa, apice subretusa, vix carunculata, laevia, badia.

Arbor 3–4 metralis. Petioli 4–5 mm. longi; laminae 5.5–8.5 cm. longae, 2.5–3.5 cm. latae. Paniculae 10–14 cm. longae. Ramuli florum marium 3–3.5 mm. longi; bracteolae 2 mm. longae; pedicelli basi articulati 4–5 mm. longi; florum diam. 2.5–3 mm. Flores foeminei: bracteae 3.5–6 mm. longae; pedicelli 4.5 mm. longi; sepala 1.5–2.5 mm. longa; columna stylari 7.5 mm. longa. Capsula 9–10 mm. longa lataque; semina 4.5 mm. longa, 4.5 mm. lata.

ZULIA: Along Río Lora, in primeval forest, flowers and fruits December 13, 1922 (*Pittier* 10931, type).

Determined at first as *M. occidentalis* Benth., but not properly referable to that group because it apparently has more than 24 stamens; its place is rather near *M. lucida* Pax & Hoffm., from which it differs mainly in the size of the capsule, the shape and size of the leaves, and in the glandular bracts of the female flowers.

Mabea longepedicellata Pittier, sp. nov.

Arbor mediocris, lactescente, coma elongata, ramis ramulisque virgatis dense hirtellis, foliis chartaceis, petiolatis, interdum oppositis; petiolis gracilibus, parce hirtellis, canaliculatis; laminis oblongis oblongo-lanceolatisve, basi rotundatis apice subtiliter apiculato-acuminatis, marginibus obtuse serrulatis revolutisque, supra sublucidis in sicco virescentibus, subtus glaucescentibus secundum marginem punctis glanduligeris ornatis, costa prominente basin versus saepe puberula, venis primariis 11–14 vix prominulis, venulis inconspicuis, acumine saepe tomentello; paniculis terminalibus multifloris rhachi tenuiter rufo-hirtella; ramulis maribus 2–3-floribus supra basin validissime biglandulosis, glandulis oblongis; bractea ovato-acuta dense puberula; pedicellis longissimis densiuscule griseo-tomentellis, medio articu-

latis; calyce cupulato, 5-6-dentato, extus griseo-tomentello; staminibus 12–20, antheris puberulis; floribus foemineis basin inflorescentiae paucis, longissime pedicellatis, pedicellis basi bracteatis, calyceque griseo-tomentellis; bracteis lanceolato-linearis, longe acuminatis, basi biglandulosis; calyce cupulato mari majore, 6-lobulato, lobis exterioribus minoribus; ovario subgloboso, columna stylari e basi sulcata stylorum parte libera multo breviora. Capsula immatura griseo-tomentella, majora, ovoidea vel subglobosa.

Arbor 8–10 metralis. Petioli 9–11 mm. longi; laminae 6–10 cm. longae, 2–3.5 cm. latae. Paniculae 10–12 cm. longae. Ramuli florum marium circa 3 mm. longi; glandulae 2 mm. longae. Bractea plus minusve 1 mm. longa. Pedicelli 6.5–14 mm. longi. Calyx circiter 1.8 mm. diam. Flores foeminei: Bractea 10–11 mm. longa. Pedicelli 16–18 mm. longi. Calyx 2 mm. longus (5 mm. diam.). Ovarium 2.5 mm. longum. Columna stylaris circa 6 mm. longa; stylorum pars libera 8–10 mm. longa. Capsula immatura 14 mm. longa.

PORTUGUESA: Between Aparición and Ospino, in forest, flowers December 26, 1925 (*Pittier* 12013, type).

Very closely related to *M. lucida* Pax & Hoffm., but differs in the indumentum of the branchlets and leaves, the dimensions of the inflorescences, the length of the pedicels, etc.

SAPIUM AUCUPARIUM Jacq., Enum. Pl. Carib. 31. 1760

Sapium albomarginatum Pax & K. Hoffm., Pflanzenreich 4, 147[17]: 203. 1924

The materials of the species of *Sapium* most common in the tierra caliente of the central parts of Venezuela were all referred in Washington to *S. Hippomane* Meyer. Pax and K. Hoffmann, on the other hand, described as belonging to a new species the specimens collected in the streets of Valencia. After a careful study of both dry and living materials, I have come to the conclusion that they all belong to *S. aucuparium* Jacq. In the first place, the spikes are never "subaggregatae" as indicated in Meyer's diagnosis, but always solitary. Neither are the leaves "obsolete serrulatis," but as a rule very neatly serrulate, though Pax and Hoffmann altered the "glanduloso-serrulatis" of Meyer, and "serrata" of Jacquin into "obscure serrulata." As to the shape of the leaves, it is found to vary greatly on the same tree and the marginal glands are no specific character in the present case. The sterile branchlets have larger leaves and in these the apex is seldom cucullate, though it invariably ends in a large gland. The margin is always more or less distinctly bordered with a cartilaginous nerve, of more or less light color, and, in the Valencia specimens, the female flowers have a 3-partite perianth, a globose ovary with the styles shortly connate, and the seeds measure about 5 mm. in length and width. It should also be mentioned that Vargas specimens, from Caracas, in the De Candolle Herbarium, were determined as *S. aucuparium*. According to my experience, the only *Sapium* found in the valley of Caracas is identical with the one common at Valencia and elsewhere in the lowlands. The close examina-

tion of the Venezuelan materials also have confirmed the opinion expressed elsewhere,[2] that *S. moritzianum* Klotzsch is, if not identical, at most a mere variety of *S. aucuparium* Jacq.

Sapium guaricense Pittier, sp. nov.

Arbor mediocris glabra, decidua, trunco erecto, ramis ramulisque cortice griseo subpapyraceo tectis; stipulis parvis, acutis, integris, scariosis, caducis; foliis mediocris, membranaceis, petiolis brevibus, canaliculatis, apice glandulis 2, crassis, retrocurvatis ornatus; laminis ovalibus, basi rotundatis late cuneatisve, apice planis abrupte brevissimeque acuminatis, acumine diminuto, minute fimbriato-glanduloso; marginibus elegantiter glanduloso-serrulatis, serraturis hic inde hydathodibus late perforatis intermixtis, supra laete viridis, subtus pallidioribus costa prominente, venisque primariis circa 12 parum obliquis arcuatis venulisque bene conspicuis; spicis in ramulis defoliatis lateralibus terminalibusque omnino masculis; glandulis mediocribus, ovatis, approximatis; bracteis parvis, late ovatis, subacutatis obtusisve, 7–11-floribus; floribus brevissime pedicellatis; calyce globoso, lobulis 2 imbricatis; staminibus 2 bene exsertis; et caeteris ignotis.

Arbor 8–10 metralis. Petioli 6–8 mm. longi; laminae 6–10 cm. longae, 2–3.5 cm. latae. Stipulae circa 2 mm. longae. Spicae 5–10 cm. longae.

GUÁRICO: Llanos de la Rubiera, in deciduous forests, male flowers only, April 12, 1927 (*Pittier* 12331, type).

Notwithstanding the young condition of the specimens and the absence of female flowers and capsules, this tree is sufficiently characterized as a new species of the *Planifolia*, but it is not possible, at present, to define its nearest affinities.

Sapium naiguatense Pittier, sp. nov.

Arbor mediocris, glabra, ramulis teretibus, cortice brunneo laevi tectis; foliis subcoriaceis, longe petiolatis, petiolo canaliculato, apice glandulis 2, validis, manifeste retroflexis, ornato, laminis late ovatis obovatisve basi cuneatis apice late rotundatis abrupte minute apiculatis acumine cucullato, supra saturate viridis subtus pallidioribus costa valida prominentissima, venis primariis 16–19 prominentibus, basi costa fere perpendicularibus, demum arcuatis, venulis prominulis, marginibus remote serrulatis, valde revolutis; floribus desunt; capsula breve stipitata, glabra, depresso-globosa, nigrescente; seminibus parvis, tuberculatis, orbicularibus.

Arbor 10 m. alta, basi 30 cm. crassa. Petioli 1–1.7 cm. longi; laminae 5–12 cm. longae, 3–5.5 cm. latae. Capsula cum stipite 1.1–1.2 cm. longa, 1.3 cm. lata; semina 5–5.5 mm. longa lataque.

FEDERAL DISTRICT: Naiguatá at 50 meters above sea-level, in cultivated places, fruits July 14, 1924 (*Pittier* 11832, type).

A remarkable species with stipitate capsules and inflexed glands. Belongs to Subsection *Cucullata*.

[2] Contr. U. S. Nat. Herb. **20**: 129. 1918.

Sapium paucistamineum Pittier, sp. nov.

Arbor mediocris, glabra, ramulis nodulosis, griseo-brunneis; foliis parvis, membranaceis; petiolis gracilibus, late canaliculatis, apice glandulis 2, parvis, brevibus, ornatis; laminis oblongis obovatisve, basi cuneatis interdum rotundatis, apice late obtusis acuminulatis acumine cucullato, supra-viridis subtus vix pallidioribus, costa prominente, venis primariis obliquis, vix arcuatis vix conspicuis; marginibus remote glanduloso-serrulatis, revolutis; spicis brevibus, terminalibus; basi 4–6 floribus foemineis sessilibus apice floribus masculis paucis gerentibus; glandulis florum foeminarum minimis orbicularibus; bractea minima, margine fimbriata; calyce bilobulato; ovario globoso, stylis basi longe connatis; glandulis florum masculorum magnis, ovatis, cohaerentibus; bractea parva, margine subintegra, floribus 1–2, pedicellatis; calyce bilobulato; staminibus 2, exsertis. Capsula deest.

Arbor 10–12 m. alta. Petioli 4–6 mm. longi; laminae 3–6 cm. longae, 1.6–2.6 cm. latae. Spicae 5–7 cm. longae.

TRUJILLO: Valera, 550 m., in bushes along Escuque River, flowers November 20, 1922 (*Pittier* 10750, type).

Very peculiar type of Subsection *Cucullata*, characterized mainly by its depauperate male spikelets, numerous female flowers and small leaves.

Euphorbia guanarensis Pittier sp. nov.

Fruticulosa, perennis, caulibus crassis, ramis ramulisque dichotomis, brevibus, crispulo-pubescentibus; foliis parvis, subcoriaceis, petiolatis, utrinque hirtellis; petiolis brevibus, laminis ovalibus, ovato-oblongis oblongisve, basi rotundatis cuneatisve, trinerviis, apice obtusis, marginibus integris vel obsolete dentatis, valde revolutis; stipulis lineari-setaceis, petiolis subaequantibus; cimis terminalibus, plurifloribus, bracteolis lanceolatis acutis pubescentibus, hirtulis, suffultis; involucris pedicellatis, campanulatis, minute puberulis, rubescentibus, lobulis orbiculari-ovatis, candidis; glandulis 4, fimbriatis; ovario crispulo-tomentello, globoso, stylis 3, brevibus, clavatis bilobulatisve coronato; capsula densiuscule cano-pubescente; seminibus laevibus, ecarunculatis, basi minutissime puberulis.

Plantula tota 5–6 cm. alta. Petioli circa 1 mm. longi; laminae 5–9 mm. longae, 2.5–5 mm. latae. Pedicelli 2–3 mm. longi. Involucra circa 3 mm. longa, lobulis 0.7–0.8 mm. longis latisque. Capsula 1.5–2 mm. longa, 2 mm. diam.

PORTUGUESA: Hato de Mata Verde near Guanare, in recently burnt savannas, flowers and fruits December 30, 1925 (*Pittier* 12072, type).

The place of this species seems to be among the *Chamaesyceae* with smooth seeds, differing at first sight from *E. amannioides* and *E. serpens* in the general hairiness.

Euphorbia meridensis Pittier, sp. nov.

Perennis, utrinque glabra, caulibus lignosis, crassis, brevibus, ramulosis, ramulis tenuibus, quadrangulis, ad nodulos incrassatis; foliis oppositis, petiolatis, coriaceis, saepe rubescentibus, petiolis brevibus, laminis obovatis ovatisve, basi subcordatis rotundatisve, apice rotundatis, mucronulatis, integris; stipulis albescentibus, geminis, triangulari-lanceolatis, minimis, denticulatis, apiculatis; involucris incarnatis, in axillis supremis solitariis, pedicellatis, infundibuliformibus, lobulis suborbicularibus, apice subtruncatis,

obsolete sinuato-denticulatis; glandulis 4-ovatis, purpureis, exappendiculatis; stylis 3, brevibus, capitellatis; capsula laevia, coccis carinatis; seminibus oblongis, laevibus, ecarunculatis.

Fruticulus 5–15 cm. alta. Petioli circa 1 mm. longi; laminae 3–6 mm. longae, 2–3.5 mm. latae. Stipulae 1 mm. longae vel minores. Capsula circa 2 mm. longa.

MÉRIDA: Páramos de los Apartaderos, 3300 m., flowers and fruits January 22, 1922 (*Jahn* 976, type).

This dwarf shrub probably belongs to Subsection *Chamaesyceae* Boiss. The diminutive involucres are solitary, the glands large and without appendages. We have no means at hand to ascertain its closest affinities. In the Prodromus there is no description, among those of American species, which would fit our specimens.

ZOOLOGY.—*Some reef corals from Tahiti.*[1] J. EDWARD HOFFMEISTER, University of Rochester. (Communicated by JOHN B. REESIDE, JR.)

The corals listed here were obtained by Dr. William A. Setchell and Mr. Harold E. Parks of the University of California from the barrier and fringing reefs around Papeete, Tahiti. There are 24 species recorded. All are typical shallow water, reef corals and most of them are common to Oceania and the surrounding areas. Some were taken from exposed parts of the barrier and fringing reefs and others from more protected areas of the reefs. One new species is recorded.

POCILLOPORA DAMICORNIS var. CESPITOSA Dana

1925. *Pocillopora damicornis* Hoffmeister, Carnegie Inst. Wash., Pub. 343, p. 15, plate 1, fig. 1. (With synonymy).

I have discussed *Pocillopora damicornis* Linnaeus and its varieties in the above mentioned publication.

Station No. 6046. Loose (dead) on Arue Reef.
No. 6084. On outer edge of exposed fringing reef, Arue.

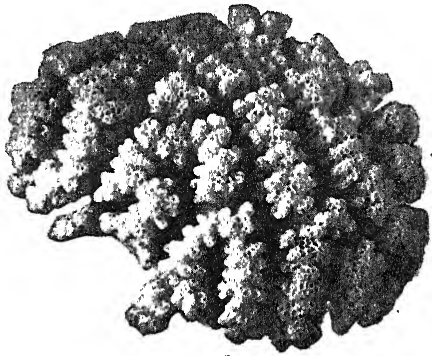
POCILLOPORA EYDOUXI Milne Edwards and Haime

1918. *Pocillopora eydouxi* Vaughan, Carnegie Inst. Wash., Pub. 213, p. 79, plate 24, figs. 1, 2, 2a. (With synonymy).

The calices of this species possess well developed septa and a large styliform columella. There are 12 septa, all of nearly the same size. Coenenchymal granulations consist of erect spinules. *P. plicata* Dana, *P. elongata* Dana, *P. coronata* Gardiner and *P. modumanensis* Vaughan are closely related species.

Station No. 6051. On outer (exposed) rim of barrier reef off Papeete, Tahiti.

[1] Received July 25, 1929.



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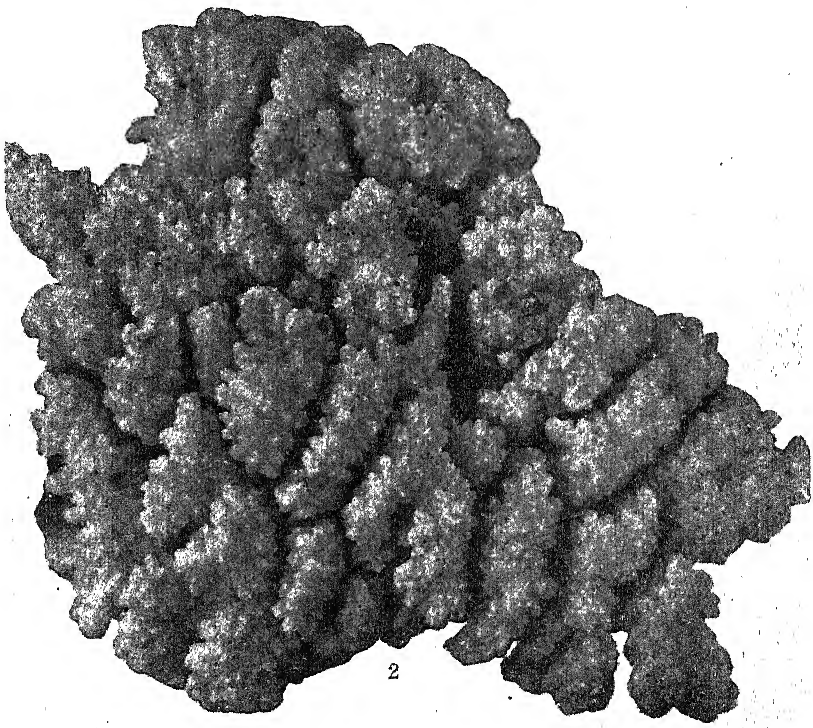

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PLATE 1

Fig. 1. *Pocillopora setchelli* Hoffmeister, n. sp. Dana's specimen No. 3979. In U. S. National Museum. Seven-eighths natural size.

Fig. 2. *Pocillopora setchelli* Hoffmeister, n. sp. TYPE. Seven-eighths natural size.

POCILLOPORA DANAE Verrill. Plate 2, fig. 2

1918. *Pocillopora danae* Vaughan, Carnegie Inst. Wash., Pub. 213, p. 77, plate 22, figs. 1, 1a, 2. (With synonymy).

One specimen agrees in most respects with the type. The bottoms of most of the calices are granulate, with no definite columella. In a few places, however, there is a distinct spine-like columella. The septal characters are typical of *P. danae*. The verrucae are not so large and tumid as those of the Murray Island specimens described by Vaughan, and thus are closer to the type.

Station No. 6085. On outer exposed edge of fringing reef at Arue.

POCILLOPORA MEANDRINA var. NOBILIS Verrill

1846. *Pocillopora verrucosa* (part) Dana, Zooph. Wilkes Expl. Exped., p. 529, pl. L, figs. 3, 3a. (Not Ellis and Solander).
1864. *Pocillopora nobilis* Verrill, Bull. Mus. Comp. Zool., 1, p. 59.
1907. *Pocillopora meandrina* var. *nobilis* Vaughan, Bull. 59, U. S. Nat. Mus., p. 98, pl. XIV, figs. 3, 4; pl. XXII, figs. 1, 1a, 2, 2a; pl. XXIII.

Vaughan has discussed this species in detail in his above mentioned paper. Verrill's *P. nobilis* is certainly to be placed with *P. meandrina* Dana. The *nobilis* variety can be distinguished by the somewhat larger and less crowded septa, and slightly larger calices. In the Tahiti specimen a few of the calices, even in the basal parts of the corallum, have septa which are fairly well-developed. This is rare however; in most places they are obsolete or very poorly developed.

Station No. 6072. An important rosette coral on outer (exposed) edge of barrier reef off Papeete, Tahiti.

Pocillopora setchelli Hoffmeister, new species. Plate 1, figs. 1, 2; plate 2, fig. 1

One specimen agrees very well with one of Dana's specimens, No. 3979 U. S. Nat. Mus. The locality of Dana's specimen is unknown and no specific name is applied. The following is a description of the Tahiti specimen:

Corallum rising from a relatively small base, sending fronds upward at every angle and forming a low, eventopped, cespitose structure. The fronds are about 4 cm. high, are tightly packed together, and appear squeezed and flattened out by the encroachment of neighboring fronds. The distance from the verrucae near the summit of one frond to those of the adjoining one is about 3 or 4 mm. Thus the space between the fronds is very narrow. The fronds are rather broad and thin. They average 3 cm. in breadth by 9 mm. in thickness including the verrucae. At times, however, they are more clump-like, thicker and shorter.

Verrucae cover the sides and tops of the fronds. They are not so numerous near the base as higher up. In most places they are 2 mm. high; diameter 2 by 2.5 mm. and 2 by 3 mm. Characteristically run in parallel rows up the side of the fronds; rows 1.5 mm. apart. The lateral verrucae are inclined towards ends of branches.

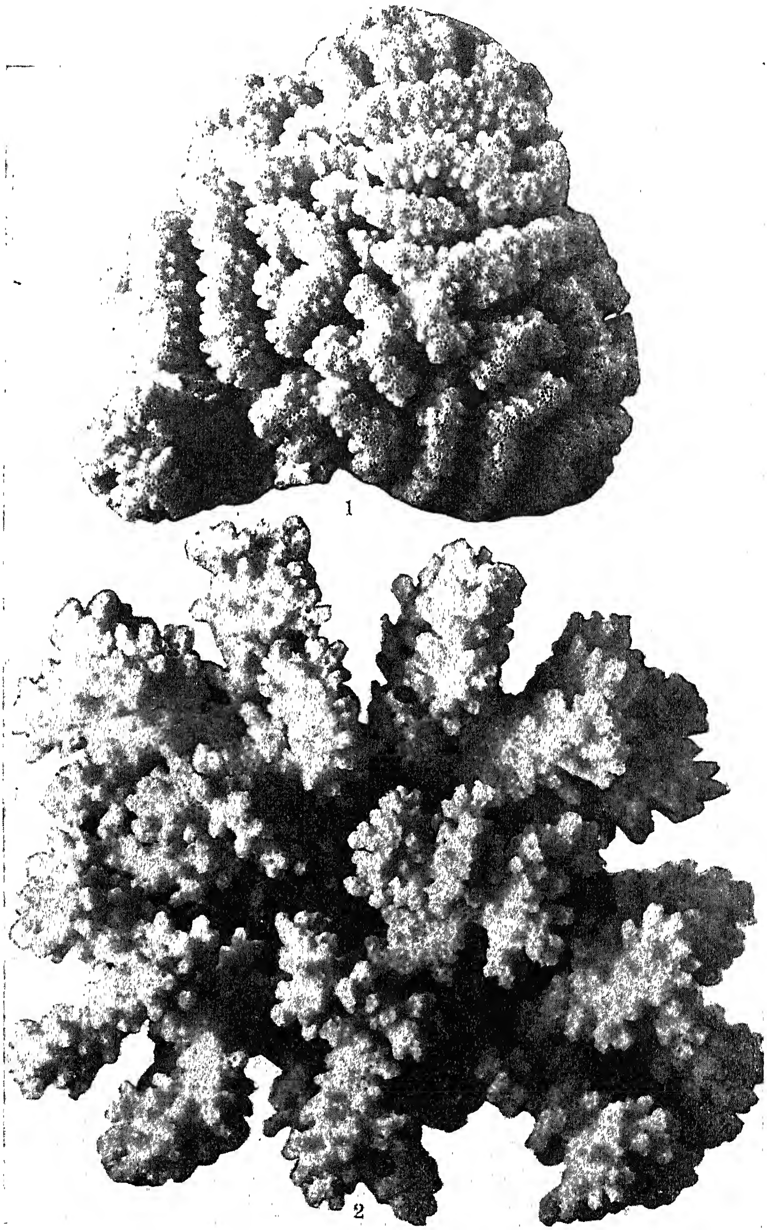

PLATE 2

Fig. 1. *Pocillopora setchelli* Hoffmeister, n. sp. From barrier reef off Papeete Harbor, Tahiti. Collected by Albatross Expedition (1899–1900). Five-sixths natural size.
Fig. 2. *Pocillopora danae* Verrill. Five-sixths natural size.

Calices variable in diameter, 0.5 mm. to 1 mm. Between the verrucae on the tips of the fronds they are in places a little less than 0.5 mm. in diameter. The intervening walls are thin at and near summits of fronds; thicker in older portions, in places 1 mm. About 24 erect granules top walls surrounding thin-walled calices. Coenenchyma compact; surface granulate. No septa visible; no columella; bottom of calices rather smooth.

This species appears to be related to *P. brevicornis* Lamarck. The compact and compressed arrangement of the fronds and the even-topped corallum are distinctive characteristics.

Two specimens of this species in the U. S. National Museum were collected by the Albatross Expedition (1899–1901) from the barrier reef off Papeete Harbor, Tahiti. They show a few calices with septa very slightly developed. Plate 1, fig. 2 shows one of these specimens. Plate 1, fig. 1 shows Dana's specimen No. 3979, U. S. Nat. Mus.

TYPE: U. S. National Museum.

Station No. 6073. Inner (protected) slope of barrier reef off Papeete, Tahiti.

LEPTASTREA PURPUREA (Dana)

1846. *Astraea purpurea* Dana, U. S. Expl. Exped., Zooph., p. 239, plate 12, figs. 10, 10a–10c.
1925. *Leptastrea purpurea* Hoffmeister, Carnegie Inst. Wash., Pub. 343, p. 20. (With synonymy).

One specimen of this well known and widely distributed species was collected at Tahiti. To my knowledge this is the first specimen recorded from there.

Station No. 6048. Loose, dead, on fringing reef at Arue.

FUNGIA CONCINNA Verrill

1902. *Fungia concinna* Döderlein, Korallengat. Fungia, p. 113, pl. 12, figs. 1–2; pl. 13, fig. 4.
1918. *Fungia concinna* Vaughan, Carnegie Inst. Wash., Pub. 213, p. 127. (With synonymy).
1921. *Fungia concinna* van der Horst, Madrepor. of Siboga Exped., part 2, p. 11. (With synonymy).

There are two typical specimens in the collection and one which is distorted. One of the former has flat, relatively thin corallum. Measures 117 mm. by 113 mm. and is nearly 15 mm. thick. The spines on the septa number from 5 to 9. The spines on the under surface are rather large; about 10 of the larger ones occupy 1 cm.

A good suite of this species was collected by the Albatross expedition of 1899–1901 and is in the U. S. National Museum.

Station No. 6060. On inner (protected) slope of barrier reef off Papeete, Tahiti.

Pavonia praetorta Dana

1846. *Pavonia praetorta* Dana, U. S. Expl. Exped., Zooph. p. 325, plate 22, figs. 5, 5a.

The species forms rounded, even, hemispherical clumps. The crispate fronds are narrow, thin and very twisted and have curled summits. The ambulacra are practically flat. The septa alternate in size although in nearly all places the smaller are almost as large as the others. The columella in the Tahiti specimens is indistinct in many calices.

Station No. 6068. On (protected) inner part of combination reef at Atiue.
No. 6053. On inner (protected) slope of barrier reef off Papeete, Tahiti.
No. 6086. On protected fringing reef at Auae, near Papeete, Tahiti.

Psammocora samoensis Hoffmeister

1925. *Psammocora samoensis* Hoffmeister, Carnegie Inst. Wash., Pub. 343, p. 46, plate 5, figs. 3a, 3b, 3c.

This belongs to the massive species of *Psammocora* and somewhat resembles *P. nierstraszi* van der Horst (Siboga Exped., part 2, 1921, p. 34, pl. 2, figs. 3, 4). The Tahiti specimen is close to No. 2 from Samoa described in Pub. 343 Carnegie Inst. Wash., p. 46. It is a small, irregularly shaped mass covered with twisted ridges.

Station No. 6047. Loose, rolling about, but living; surface of fringing reef at Arue.

Montipora gracilis Klunzinger

1879. *Montipora gracilis* Klunzinger, Korallenthiere des Rothen Meeres, ii, p. 37, pl. VI, fig. 7; pl. V, fig. 12; pl. X, fig. 9.

Station No. 6070. Protected surface of combination reef at Atiue.

Montipora australiensis Bernard

1897. *Montipora australiensis* Bernard, Brit. Mus. Cat. Madrepor., vol. 3, p. 95, pl. 17, fig. 3; pl. 33, fig. 8.

In the U. S. National Museum there are several specimens of this species from Tahiti. Most of them are larger than the one obtained by Setchell and Parks. Bernard's description and plates give a good picture of the species. This species and the preceding one belong to the papillate group.

Station No. 6057. Lurid purple, encrusting coral, very common on protected portions of both fringing and barrier reefs off Papeete, Tahiti.

Acropora formosa (Dana)

1846. *Madrepora formosa* Dana, U. S. Expl. Exped., Zooph., p. 473.
1846. *Madrepora brachiata* Dana, U. S. Expl. Exped., Zooph., p. 474.
1846. *Madrepora gracilis* Dana, U. S. Expl. Exped., Zooph. p. 482.
1893. *Madrepora formosa* Brook, Cat. Genus Madrepora, p. 43.
1925. *Acropora formosa* Hoffmeister, Carnegie Inst. Wash., Pub. 343, p. 55, pl. 8, figs. 1, 2a, 2b, 3a, 3b.

I have discussed this species in my Samoan report and have combined *A. brachiata* (Dana) and *A. gracilis* (Dana) with it as varieties. The *gracilis* variety has thinner stems than the *brachiata* variety and the two grade into each other. I am referring the two branches from Tahiti to *A. formosa* var. *gracilis* (Dana).

Station No. 6067. Low, scattering, on shallows of protected fringing reef off Fareute Point, Papeete, Tahiti.

Acropora corymbosa (Lamarck)

1893. *Madrepora corymbosa* Brook, Cat. Genus Madrepora, p. 97.
1918. *Acropora corymbosa* Vaughan, Carn. Inst. Wash., Pub. 213, p. 171, pl. 67, fig. 1. (With synonymy).

Four specimens of various sizes were collected. One (No. 6052) has a small, cespitose corallum which has not as yet taken on the corymbose form. The other three are more mature. Besides these there are quite a few other specimens in the U. S. National Museum belonging to this species. One was collected by the Albatross Expedition of 1899–1901, from Papeete Harbor, Tahiti; one was sent by Dr. Fred Baker from Fanning Island, one by Dr. F. Wood Jones from Cocos-Keeling, and Dr. Alfred Mayor collected several from Pago Pago Harbor, Tutuila, Samoa.

Station No. 6074. Inner (protected) slope of barrier reef off Papeete.
Nos. 6062, 6063. Exposed edge of fringing reef along the pass at Atiue.
No. 6052. On outer edge (exposed) of barrier reef off Papeete.

Acropora leptocyathus (Brook).

1893. *Madrepora leptocyathus* Brook, Cat. Genus Mad., p. 159, pl. 16, fig. C.
1925. *Acropora leptocyathus* Hoffmeister, Carnegie Inst. Wash., Pub. 343, p. 67, plate 17, figs. 1a to 1d.

I am placing with this species two specimens which differ somewhat from typical *A. leptocyathus*. They are close enough to be regarded a variety. I have examined a large suite of specimens of the species from Samoa and am familiar with the variation within it. The Tahiti specimens possess axial corallites which are slightly larger in diameter than is customary. They measure in places as much as 3 mm. to 3.5 mm. across. Some of the Samoan specimens have axial corallites of 3 mm. diameter also, although this is not typical.

Stations No. 6069, 6065. Outer (exposed) margin of fringing reef of pass at Atiue.

Acropora nasuta (Dana)

1846. *Madrepora nasuta* Dana, U. S. Expl. Exped., Zooph. p. 453, plate 34, figs. 2, 2a, 2b.

Dana's types of this species from Tahiti are in the U. S. National Museum.

Station No. 6064. Outer margin (exposed) of fringing reef of pass at Atiue.

No. 6075. Inner slope (protected) of barrier reef off Papeete, Tahiti.

Acropora paxilligera (Dana)

1893. *Madrepora paxilligera* Brook, Cat. Mad. Corals in Brit. Mus. (Nat. Hist.), vol. 1, p. 74.

Besides Tahiti the species has been reported from Fiji and the Mergui Archipelago.

Station No. 6077. Inner (protected) slope of barrier reef off Papeete, Tahiti.

Acropora plantaginea (Lamarck)

1893. *Madrepora plantaginea* Brook, Cat. Mad. Corals in Brit. Mus. (Nat. Hist.),.p. 156. (With synonymy).

The species is quite similar to Dana's *A. retusa*. It has been reported from Samoa, Singapore and Ceylon besides Tahiti.

Station No. 6076. Inner (protected) slope of barrier reef off Papeete.

Acropora pectinata (Brook)

1918. *Acropora pectinata* Vaughan, Carnegie Inst. Wash., Pub. 213, p. 172, plate 71, figs. 1, 1a, 1b, 1c, 2.

Station No. 6050. Scattered along the outer (exposed) edge of the fringing reef at Arue.

Acropora cytherea (Dana)

1846. *Madrepora cytherea* Dana, U. S. Expl. Exped., Zooph., p. 441, pl. 32, fig. 3.
1893. *Madrepora cytherea* Brook, Cat. Genus Madrepora, p. 99.

This is one of the most characteristic species of Tahiti. There are a number of immense specimens from that locality in the Dana collection in the U. S. National Museum including the type. The species seems to pass through the same growth stages as are characteristic of *A. hyacinthus* Dana, which is described in my Samoan report.

Station No. 6045. Outer (exposed) rim of reef at Arue.

No. 6058. Scattered platform corals on inner slope (protected) of barrier reef off Papeete. The solid vasiform bases of old specimens are so very large as to form "negro heads" when tossed about on the reef. They ring like metal when struck with the hammer.

PORITES LATISTELLATA Quelch

1886. *Porites latistellata* Quelch, Chall. Exped., XVI: 185; pl. XI, figs. 6, 6a.
1886. *Napopora irregularis* Quelch, Chall. Exped., XVI: 186; pl. VIII, figs. 6, 6a.
1905. *Porites* "Society Islands (3) (2)," Bernard, The Genus Porites, p. 29, pl. X, fig. 4.

Station No. 6080. In shallows, surface of protected fringing reef at Auae, near Papeete, Tahiti.

PORITES (SYNARAEA) CONVEXA (Verrill)

1864. *Synaraea convexa* Verrill, Bull. Mus. Comp. Zool., i, p. 43.
1905. *Porites* "Society Islands (3) 3," Bernard, The Genus Porites, p. 30, pl. I, figs. 3, 4, 5; pl. X, fig. 5.

Stations Nos. 6078, 6079. Protected fringing reef at Auae, near Papeete. Nos. 6055, 6056. Growing in clumps on outer edge of protected fringing reef off Fareute Point, Papeete.

PORITES (SYNARAEA) UNDULATA (Klunzinger)

1879. *Synaraea undulata* Klunzinger, p. 48, pl. 6, fig. 12; pl. 5, fig. 30.
1906. *Porites undulata* von Marenzeller, Denkschr. k. k. Akad. Wiss. Wien, **80**: 66; pl. 22, fig. 75. (With synonymy).

Station No. 6083. On protected fringing reef at Auae, near Papeete, Tahiti.

MILLEPORA TRUNCATA Dana

1846. *Millepora platyphylla, β truncata* Dana, U. S. Expl. Exped., Zooph., p. 548, pl. 53, fig. 2.
1918. *Millepora truncata* Vaughan, Carnegie Inst. Wash., Pub. 213, p. 207, pl. 93, figs. 3, 3a, 3b.

Station No. 6049. In large and deeply indented, sulphur-yellow masses, along sides of small tideway, (exposed) fringing reef at Arue.

DISTICHOPORA VIOLACEA (Lamarck)

1846. *Distichopora violacea* Dana, U. S. Expl. Exped., Zooph., pl. 60, figs. 3, 3a.

Station No. 6071. Deep blue, scattered colonies, in crevices and underneath overhanging corals, abundant on the inner (sheltered) slope of barrier reef off Papeete.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

BIOLOGICAL SOCIETY

736TH MEETING

50TH ANNUAL MEETING

The 736th regular and 50th annual meeting of the Biological Society was held in the New Assembly Hall of the Cosmos Club May 18, 1929, at 8.10 p.m., with President GOLDMAN in the chair and 23 persons present. New members elected: F. W. APPEL, J. I. HAMBLETON, J. M. HOLZWORTH.

The reports of the Recording Secretary, Corresponding Secretary, Treasurer, and Publication Committee were read and ordered accepted and placed on file. The report of the Auditing Committee was presented. Dr. OBERHOLSER gave an informal report for the Board of Trustees.

The election then took place, resulting as follows:

President, ALEXANDER WETMORE; *Vice-Presidents,* C. E. CHAMBLISS, H. H. T. JACKSON, C. W. STILES, T. E. SNYDER; *Recording Secretary,* S. F. BLAKE; *Corresponding Secretary,* W. H. WHITE; *Treasurer,* F. C. LINCOLN; *Members of Council,* H. C. FULLER, W. R. MAXON, A. A. DOOLITTLE, I. HOFFMAN, and E. P. WALKER.

The following amendments to the Constitution and By-Laws were then adopted:

1. For Constitution, Art. III, substitute:

   The members of the Society shall be persons who are interested in biological science. There shall be two classes of members, active and emeritus.
2. In By-Laws, Art. I, delete paragraph 1.
3. For By-Laws, Art. I, paragraph 2, substitute:

   Active members in government service who are retired for age or disability, and members not in government service upon reaching the age of 70, may be transferred by the Council to the class of emeritus members. Emeritus members shall have all rights and privileges of active members, including that of receipt of such notices and publications of the Society as they were receiving at time of such transfer, without payment of any further dues. These provisions shall apply only to those who have been members for at least fifteen years.
4. In By-Laws, Art. III, paragraph 1, omit the words "and corresponding."
5. In By-Laws, Art. III, paragraph 2, omit "of either class."

The business meeting adjourned at 9.05 p.m., and a special meeting, with President WETMORE in the chair, was held in celebration of the 50th annual meeting of the Society. Drs. L. O. HOWARD, C. W. STILES, and W. P. HAY presented interesting recollections of the early days of the Society and of some of its prominent members.

S. F. BLAKE, *Recording Secretary.*

BOTANICAL SOCIETY

The 169th to 177th regular meetings of the Botanical Society were held from October, 1923, to May, 1924; the 178th to the 185th from October, 1924, to April, 1925; the 186th to the 193d from October to May, 1926; the 194th to the 202d from September, 1926 to May, 1927; the 203d to the 210th from October, 1927, to May, 1928. The proceedings were not published during this period, the last, that for the 168th meeting, being printed in this JOURNAL in February, 1924. The 200th meeting, held March 1, 1927, was devoted to the history of the society. The addresses were mimeographed and distributed to the members.

211TH MEETING

The 211th meeting was held at the Cosmos Club October 2, 1928.

Program. Address of the retiring President, ROBERT F. GRIGGS: *A new key to the families of flowering plants.*

212TH MEETING

The 212th meeting was held at the Cosmos Club November 6, 1928. The program consisted of several papers on seed germination. E. H. TOOLE: *Dormancy.* Miss A. M. ANDERSON: *Histology* (illustrated). W. L. GOSS: *Current tests.* EDGAR BROWN: *Interpretation* (illustrated).

213TH MEETING

The 213th meeting was held at the Cosmos Club December 4, 1928.

Biographical sketches were given of members who had died during the year, F. G. O'DONNELL by N. REX HUNT, and J. N. ROSE by WALTER H. EVANS.

Program. FREDERICK V. COVILLE: *Recent experiments with blueberries* (illustrated).

S. F. BLAKE: *Recent studies on the genus* Bidens.

O. M. FREEMAN: *The propagation of the flowering dogwood,* Cornus florida L. (illustrated).

214TH MEETING

The 214th meeting was held at the Cosmos Club January 11, 1929.

Program. H. H. MCKINNEY: *Studies on viruses and mosaic diseases* (illustrated).

M. B. MCKAY: *Status of curly top in the west* (illustrated).

C. H. GODFREY: *Pineapple culture in Hawaii* (illustrated).

215TH MEETING

The 215th meeting was held at the Cosmos Club February 5, 1929, with President GRIFFITHS in the chair.

Program. EDGAR T. WHERRY: *Studies on eastern Phloxes* (illustrated).—In the course of studies on soil reaction as related to plant distribution it was found that the species of *Phlox* in the eastern United States had never been satisfactorily characterized, so work on them has been started. The Section *Subulatae,* comprising creeping types with narrow persistent leaves, proves to include three species, *Phlox nivalis* Lodd. of the southeastern, *P. subulata* L. of the northeastern, and *P. bifida* Beck of the north-central states. A series of lantern slides was shown, including for each species his-

torical records, habitat views, and close-ups bringing out their significant features. (*Author's abstract.*)

Mrs. A. M. Hurd-Karrer. *Temperature effects on leaf acidity and moisture in relation to vigor of the wheat plant* (illustrated.)—The concentration of hydrogen ions in leaf juice of both spring and winter wheats grown at temperatures of 12–18, 20–25, and 25–30° C., respectively, was lowest at the low temperature and highest at the high temperature. Plants growing at the medium temperature had the lowest "titratable acidity," however. The magnitudes of the titratable acid values were closely correlated with the specific gravity measurements and with the percentages of dry matter in the leaves, which were also lowest at the medium temperature and highest at the high temperature. The increase in hydrogen-ion concentration induced by the higher temperatures was found to depend on the adaptability of the variety to the particular temperature, the winter wheats being the least adapted to the higher temperatures. Those plants which grew the most vigorously had pH values near 6.0 throughout their vegetative development, and up to the final stage in the maturation period when the acidity values increased normally. Those plants which were so injured that they failed to develop beyond the shooting stage had much higher hydrogen-ion concentrations at each stage of development, extreme injury being accompanied by values near 5.6 while the plants were still in a vegetative stage. (*Author's abstract.*)

Freeman Weiss and W. A. Whitney. *Evaporation effects on stock fungous cultures in mechanical and ice-cooled refrigerators* (illustrated).—Based on the theory of action of mechanical refrigerators, on the claims of manufacturers of these appliances, and on the very limited data showing actual performance records in mechanical and ice-cooled refrigerators, it is a commonly accepted notion that the atmosphere of a mechanical refrigerator is relatively dry, that of an ice-cooled refrigerator relatively humid. The cause of the relatively drier atmosphere in mechanical refrigerators is, of course, the condensation of moisture as ice on the evaporator coil, which is usually maintained below 0°C., as contrasted with the giving off of moisture from melting ice in the other type of refrigerator. The opinion that mechanical refrigerators are drier than ice-cooled ones overlooks the fact that the temperatures ordinarily maintained in the two types of refrigerators also differ, and that the circulation of air within the chamber and the rate of air exchange with the surrounding also have an important effect on the evaporating power of the internal atmosphere. Stock fungous cultures are stored in refrigerators principally in order to reduce evaporation and for this purpose mechanical refrigerators have sometimes been considered undesirable. A comparison of the evaporation rate as measured by porous-cup atmometers in two refrigerators of generally similar construction and maintained at approximately the same temperature (48–49°F.) one cooled by ice, the other by a standard refrigerating mechanism, showed that the rate was higher in the ice-cooled chamber, the comparative measures being 0.241 and 0.534 cc. per hour during a test period of 4,008 hours. Uninoculated tubes of an agar culture medium also showed greater drying out in the ice-cooled chamber, the water loss being 0.487 gr. per tube as compared with 0.446 gr. per tube in those stored in a mechanical refrigerator. In this instance, the lower evaporation rate in the mechanical refrigerator is attributed to its more equable temperature and a generally higher humidity. No freezing out of moisture occurred when the mechanical refrigerator was maintained at this temperature. A brief account of the physical factors influencing evaporation was given. (*Author's abstract.*)

216TH MEETING

The annual dinner of the Botanical Society was held at Meridian Mansions Hotel, the evening of March 12, 1929. Secretary and Mrs. WILLIAM JARDINE and Doctor and Mrs. E. W. BRANDES were the guests of honor. The dinner was preceded by a reception by Secretary JARDINE. After the dinner, with Dr. DAVID GRIFFITHS presiding, addresses were made by Secretary JARDINE, Dr. W. A. TAYLOR, and Dr. KARL F. KELLERMAN, followed by the regular program.

E. W. BRANDES: *Botanical explorations in New Guinea* (illustrated with motion pictures).

217TH MEETING

The 217th meeting was held at the Cosmos Club April 2, 1928.

Program. CHARLES F. SWINGLE: *Botanical exploration in Madagascar* (illustrated with lantern slides, motion pictures, and ethnological specimens).—Dr. Henri Humbert, Professor of Botany, University of Algiers, and the speaker left Marseilles June 7, 1928, for Madagascar, on a plant exploration expedition sponsored by the University of Algiers, the Arnold Arboretum of Harvard University and the United States Department of Agriculture. This was Dr. Humbert's third trip to Madagascar, but it was the first time an American botanist had ever visited France's "Great African Island." The party entered Madagascar from the north but most of the time was spent in the little known southwest, an arid region characterized by an extensive and very peculiar native flora, including tree Euphorbias, some 30 or 40 feet high. The expedition traveled partly by automobile, partly by boat, but in the southwest the *filanzana*, a kind of sedan chair, was employed. The speaker returned to Washington in November with the living plant material, while Dr. Humbert remained in Madagascar until February, then going into Tanganyika and Kenya to compare the flora there with that of Madagascar. The party collected some 3000 herbarium numbers, and a considerable quantity of living plants. The real prize of the expedition consisted of living specimens of *Euphorbia intisy*, a plant known to yield a rubber of very high quality, but one practically exterminated because of the ruthless collecting methods employed by the natives. (*Author's abstract*).

218TH MEETING

The 218th meeting was held at the Cosmos Club May 7, 1929.

Program. ERNST ARTSCHWAGER: *Anatomical studies of the epidermis of the sugar cane plant in relation to its taxonomy and genetics* (illustrated).

CHARLES DRECHSLER: *A review of the genus* Pythium *and some related fungi* (illustrated).

VICTOR F. TAPKE: *The rôle of humidity in the occurrence of smut in wheat, oats, and barley* (illustrated).

LEWIS H. FLINT, *Recording Secretary.*

SCIENTIFIC NOTES AND NEWS

International Lighthouse Conference

The first International Lighthouse Conference that has ever been held, met in London in July on the invitation of Trinity House, the English Lighthouse Authority. Trinity House is an organization with a long record of high achievement in the Lighthouse work of the world. It holds a charter granted in 1514, and it has carried out some of the most important lighthouse engineering works, such as the building of the lighthouses on Eddystone Rock and Bishop Rock. It has included among its engineers Smeaton and Douglas, and on the governing board, known as the Elder Brethren of Trinity House, have been many of the noted men of England.

The Conference included representatives of the Lighthouse authorities of 24 countries, and also of a number of local lighthouse organizations and interested industries. The Conference was entirely informal, and its purpose was the exchange of information, and the discussion of problems affecting lighthouse systems; it did not undertake to pass final judgment on any matter. The Conference was opened under the presidency of the Master of Trinity House, the Duke of Connaught, and the Chairman of its meetings was Admiral Mansell, the Deputy Master. Sessions were held from July 8 to July 12, and during the following week inspection trips were made to various works. The principal topics of discussion were lighthouse illuminants, unattended lighting systems, aerial lights, floating aids to navigation, including lightships and buoys, lighthouse structures, fog signals, radiobeacons, and other related matters. Much interesting information was presented, both in formal papers submitted in advance, and in discussion at the Conference. The proceedings will be published by Trinity House. The representatives of the United States were: George R. Putnam, Commissioner of Lighthouses, Washington, J. T. Yates, Superintendent of the Third Lighthouse District, New York, and H. W. Rhodes, Superintendent of the Eighteenth Lighthouse District, San Francisco, all of the Department of Commerce.

Obituary

Harry C. Frankenfield, in charge of the River and Flood Division of the U. S. Weather Bureau, and a member of the Academy, died July 29, 1929, as a result of injuries received when struck by an automobile the evening of July 22. He was born at Easton, Pennsylvania, November 24, 1862, and entered the meteorological service, then under the Signal Corps of the Army, in 1882. After completing the prescribed course at the Signal Service School at Fort Whipple, Virginia, (now Fort Myer) he was assigned to the Central Office in Washington. In 1887 he was put in charge of the Chicago station; from 1894 to 1898 he served at the St. Louis office, and from 1898 to 1920 was one of the official forecasters at the Central Office. He was in charge of the River and Flood Service 1898–1912, and from 1920 to the time of his death. He received the degrees of A.B. (1881) and A.M. (1884) from Lafayette College, and M.D. (1886) from Howard University (which at that time was attended by many white students), and was the author of numerous papers and bulletins, chiefly on topics connected with floods. His outstanding scientific contribution was the development of methods of numerical computation by means of which flood stages at various places can be closely foretold, days to weeks in advance, from the conditions existing upstream.

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CHEMISTRY.—*A reaction between soils and metallic iron.*[1] H. D. Holler, Bureau of Standards. (Communicated by R. C. Wells.)

Introduction

In connection with the Bureau of Standards Soil-Corrosion Studies, which have been in progress for several years, the problem of determining the causes of corrosion of iron or steel in different soils is of scientific as well as of practical interest. A solution of this problem would enable one to distinguish soils, which are corrosive to ferrous materials, from less corrosive soils, and therefore would be of practical assistance to one charged with the responsibility of protecting pipe lines from corrosion. It was hoped that a procedure might be developed whereby the relative corrosiveness of soils could be determined in the laboratory within a few days—a determination which now requires a period of years. While this hope has not been completely realized, some information regarding a reaction between soils and metallic iron has been obtained, which may be of interest to those who are more concerned with the properties of soils than with the corrosion problem. The scope of this paper is therefore limited to a presentation of some data on this reaction.

In order to obtain a test by which results could be obtained within a short period of time, it was necessary either to devise a very sensitive method of measuring the rate of corroding action or to choose conditions which would perceptibly increase this rate. To a certain extent, both of these objects were accomplished by measuring the volume of hydrogen gas evolved from a wet mixture of soil and pulverized metallic iron.

[1] Publication approved by the Director of the U. S. Bureau of Standards, Department of Commerce. Received August 5, 1929.

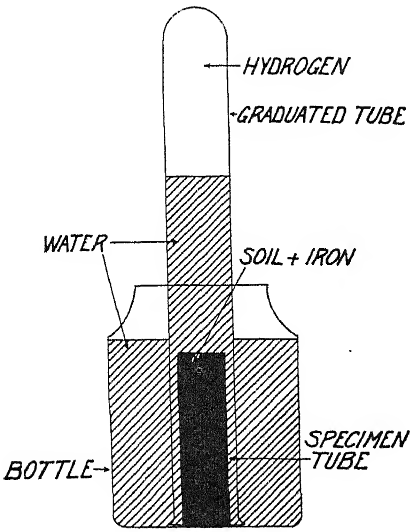


Fig. 1.—Arrangement of apparatus for collecting hydrogen gas evolved from a mixture of soil and pulverized iron.

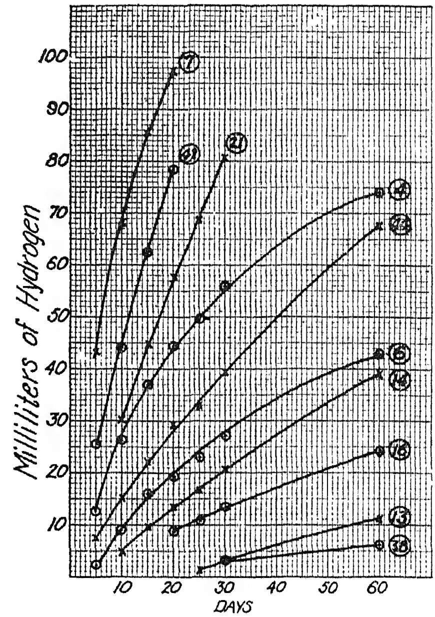


Fig. 2.—Comparative rates of hydrogen evolution obtained with 10 different soils.

Evolution of Hydrogen

Shipley[2] observed the evolution of hydrogen from the reaction of clay on cast iron, and pointed out the importance of the buffer effect of clay in maintaining the reaction over a period of time. He also suggested the probable effect of fine soil particles in reducing the overvoltage of hydrogen on the metal surface, thereby facilitating gas evolution. The writer found that the volumes of hydrogen gas evolved from different mixtures of a soil and pulverized iron or steel, under the same set of conditions, depend upon the soil and agree so closely in successive trials that the reaction may be considered as an individual characteristic of that soil.

The effects of different factors, such as fineness of metal, temperature, etc., were studied only in a qualitative way. The ferrous materials were limited to very fine steel turnings and to pulverized cast iron, both of which reacted equally well. The latter was preferred because of the ease of preparing it. This was accomplished by grind-

[2] Ind. Eng. Chem. 17: 381. 1925.

ing borings in an iron mortar and sieving out the size desired. The size used in the present tests passed through a "60-mesh" sieve. The method used for collecting and measuring the gas is illustrated in Figure 1. As convenient amounts of materials, 7.5 grams each of soil and pulverized cast iron were thoroughly mixed and poured into distilled water contained in a specimen tube. The latter was then placed in a short bottle standing in a tall beaker full of water. The graduated test tube, full of water, was then inverted over the sample. By this procedure, the mixture quickly became uniformly wet, and no perceptible amount of air was trapped. In this series of tests the time of the experiments was limited by the size (about 100 ml.) of the collecting tube.

Most of the soils listed in Table 1 were tested. In Figure 2, curves are given for ten of these soils, which represent practically the full range in activity observed. Some irregularities in the readings were obtained when bubbles of gas were trapped in the wet soil, but these were insignificant. The rate of evolution for each soil was sufficiently steady throughout the course of the test so that a comparison of rates could be made at the end of any convenient period of time. For example, the volume of gas after 20 days under specific conditions may be taken as a comparative measure of the ability of the soil to liberate hydrogen gas.

No attempt was made to elaborate upon the method of measuring the gas for the purpose of obtaining more accurate data. Attention was directed to the more important purpose of finding some other property of the soils which might be related to, and possibly be the cause of, their activity on iron.

The results of the tests showed that the amount of hydrogen evolved by a soil is not dependent upon its pH value alone. A low pH value does not necessarily indicate that the soil will give a high rate of evolution. If, however, the soil has a low pH value, together with enough material capable of buffering the solution at this pH value, a high rate may be expected. Thus, clays and silt loams are usually more active than sands. These observations indicate that the hydrogen evolved is dependent not only upon the concentration of hydrogen ions but also upon the available supply of hydrogen ions. Since this supply resides principally in the colloidal portion of the soil, it may be roughly estimated by determining the pH value and also the percentage content of colloidal matter.

TABLE 1. SOILS AND LOCATIONS

BUREAU OF STANDARDS SOIL-CORROSION INVESTIGATION

Soil No.	Soil Name	Locations
1	Allis silt loam	Cleveland, Ohio
2	Bell clay	Dallas, Texas
3	Cecil clay loam	Atlanta, Ga.
4	Chester loam	Jenkintown, Pa.
5	Dublin clay adobe	Oakland, Calif.
6	Everett gravelly sandy loam	Seattle, Wash.
7	Fairmount silt loam	Cincinnati, O.
8	Fargo clay loam	Fargo, N. D.
9	Genesee silt loam	Sidney, O.
10	Gloucester sandy loam	Middleboro, Mass.
11	Hagerstown loam	Baltimore, Md.
12	Hanford fine sandy loam	Los Angeles, Calif.
13	Hanford very fine sandy loam	Bakersfield, Calif.
14	Hempstead silt loam	St. Paul, Minn.
15	Houston black clay	San Antonio, Texas.
16	Kalmia fine sandy loam	Mobile, Ala.
17	Keyport loam	Alexandria, Va.
18	Knox silt loam	Omaha, Nebr.
19	Lindley silt loam	Des Moines, Ia.
20	Mahoning silt loam	Cleveland, Ohio.
21	Marshall silt loam	Kansas City, Mo.
22	Memphis silt loam	Memphis, Tenn.
23	Merced silt loam	Buttonwillow, Calif.
24	Merrimac gravelly sandy loam	Norwood, Mass.
25	Miami clay loam	Milwaukee, Wis.
26	Miami silt loam	Springfield, O.
27	Miller clay	Bunkie, La.
28	Montezuma clay adobe	San Diego, Calif.
29	Muck	New Orleans, La.
30	Muscatine silt loam	Davenport, Ia.
31	Norfolk sand	Jacksonville, Fla.
32	Ontario loam	Rochester, N. Y.
33	Peat	Milwaukee, Wis.
34	Penn silt loam	Norristown, Pa.
35	Ramona loam	Los Angeles, Calif.
36	Ruston sandy loam	Meridian, Miss.
37	St. Johns fine sand	Jacksonville, Fla.
38	Sassafras gravelly sandy loam	Camden, N. J.
39	Sassafras silt loam	Wilmington, Del.
40	Sharkey clay	New Orleans, La.
41	Summit silt loam	Kansas City, Mo.
42	Susquehanna clay	Meridian, Miss.
43	Tidal marsh	Elizabeth, N. J.
44	Wabash silt loam	Omaha, Nebr.
45	Unidentified alkali soil	Casper, Wyo.
46	Unidentified sandy loam	Denver, Colo.
47	Unidentified silt loam	Salt Lake City, Utah

Estimation of Acidity

A more direct determination of the total supply of hydrogen ions, that is, "total acidity" of the soil seemed desirable for the purpose of a direct comparison with the amount of hydrogen evolved. A titration of the acidity of soils encounters difficulties, such as the detection of the end-point, time-lag of the neutralization, and the probability of constituents, other than acid, combining with part of the titrating solution. The possibility of titration with a hydrogen electrode for ascertaining the end-point seemed to be worth consideration. Accordingly, a thinly platinized platinum wire electrode supplied with hydrogen from a tank was tried. It was measured against a tenth-normal calomel electrode. The 20-gram samples of soils were stirred vigorously in 200 ml. of 5 per cent potassium chloride solution with a motor-driven propeller and titrated with a normal solution of potassium hydroxide. The stirring was started immediately after each addition of alkali but was stopped for making the readings.

Consistent readings were obtained only in the presence of the potassium chloride. This was no doubt partly due to the increased conductivity, but other reasons were probably more important. Thus, the use of this salt involves a consideration of the "base exchange" effect, according to which the hydrogen ions attached to the soil particles are exchanged for potassium ions. This would result in the presence of hydrochloric acid with which the alkali would react more readily than with the soil material. If the base exchange process simply involves a transfer of the hydrogen ions from the soil particles to the solution, and if this transfer is complete, then the hydrochloric acid ought to be equivalent to the original acidity of the soil. Then also, titration of the soil in a potassium chloride solution should be a measure of the total acidity of the soil. Whether this is true cannot be answered here.

In order to show the consistency of the readings, several titration curves for a single soil are presented in Figure 3, for which all of the readings were plotted. In Figure 4, titration curves for several typical soils are given. The curves for soils Nos. 42, 43 and x are of the strong-acid type, such as might be expected with hydrochloric acid. Those for Nos. 33 and 37 indicate buffer material associated with the high content of organic matter in these soils. The remaining soils represented in Figure 4 require different amounts of alkali to increase their pH values by a given amount, but their curves are not of the shape usually obtained in neutralization processes.

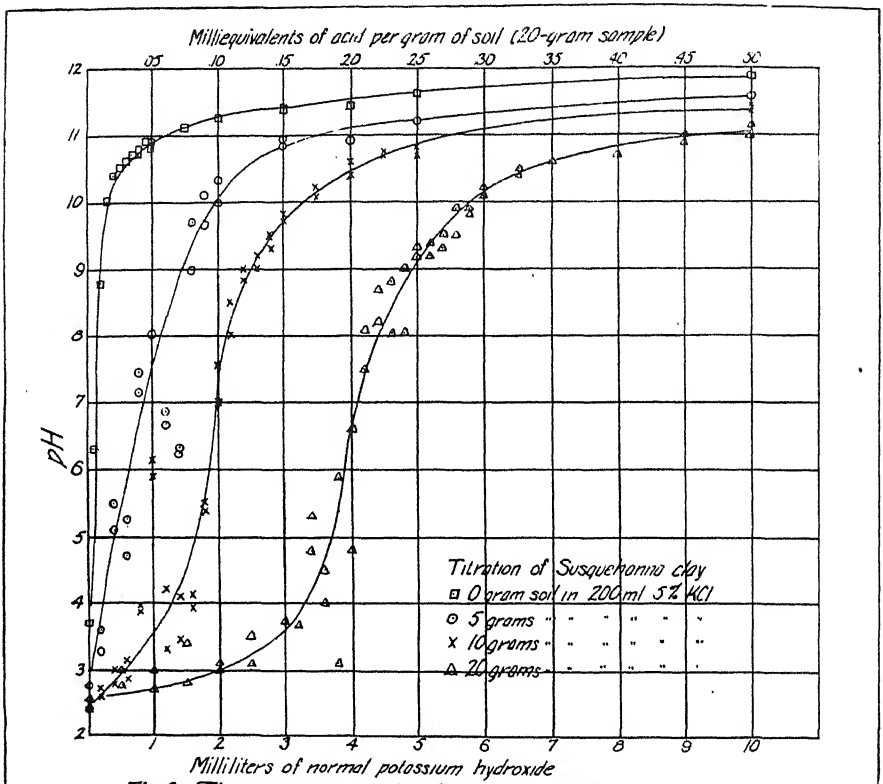


Fig 3 Titration curves for Susquehanna clay

In connection with the reaction of these soils on iron, the question arises, "What pH value should be taken as the end-point in the above-mentioned titrations?" This question may be answered if consideration is given to the change in pH which occurs when iron reacts with wet soil. Shipley and McHaffie[3] have experimentally shown that, in the absence of oxygen, iron corrodes until the pH value of the surrounding solution rises to about 9.4, corresponding to the solubility product of ferrous hydroxide. The writer has also observed that wet mixtures of soil and pulverized iron, with air excluded, practically cease to evolve gas after the pH has reached a value of 9.4 to 9.6.

[3] Can. Chem. Met. 8: 121. 1924.

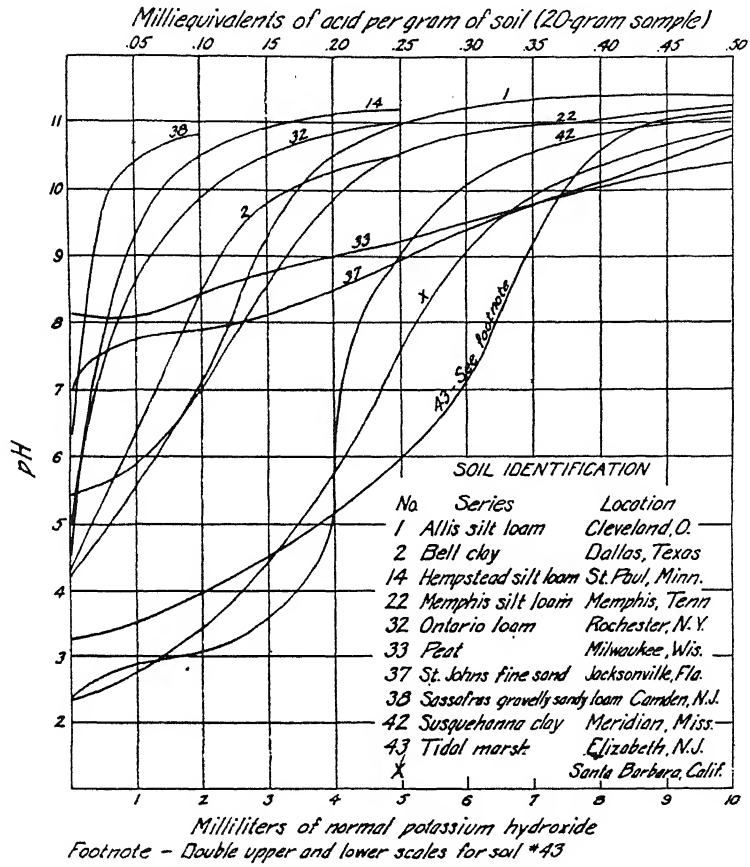


Fig. 4 Titration curves for different soils.

For our present purpose, therefore, it seems reasonable to consider a pH value of 9.4 as the end-point in these titrations. If then the total acidity of the soil, as measured by the above titration, is related to the ability of the soil to liberate hydrogen, such a relation should be demonstrated by plotting the volumes of gas evolved in a given time by different soils against the total acidity of these soils. This has been done in Figure 5, where the points are denoted by the soil numbers, which refer to the soils listed in Table 1.

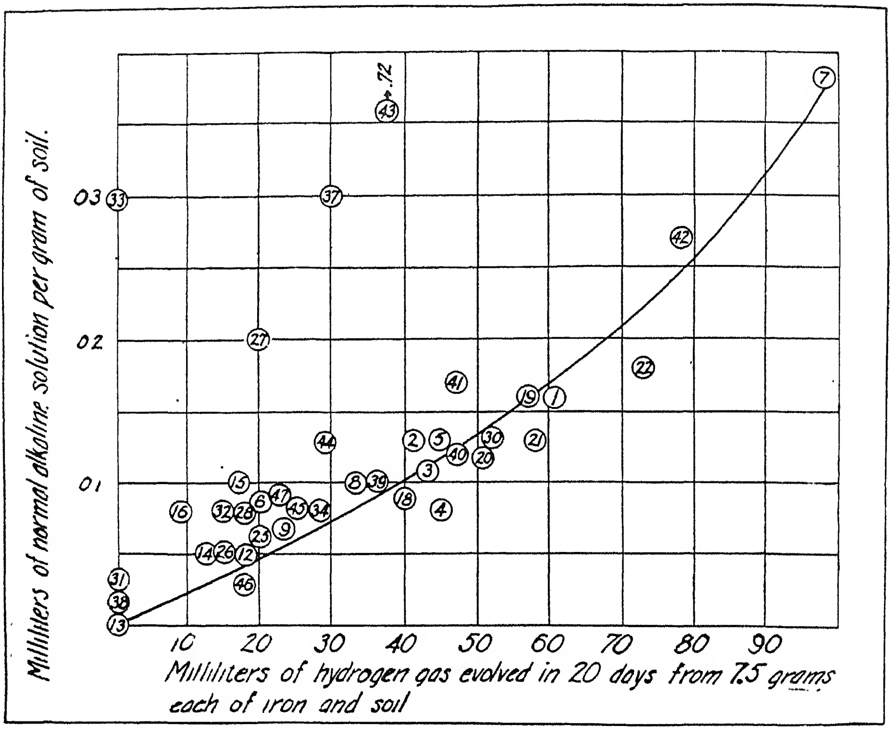


Fig 5 A comparison of the property of soils of liberating hydrogen, when reacting with iron with their property of combining with potassium hydroxide

Conclusions

The data in Figure 5 seem to justify the conclusion that a relation exists between the activity of a soil on iron, as measured by the amount of hydrogen evolved, and the acidity of the soil as measured by titration; moreover, that the acidity is probably the direct cause of its activity. The outstanding exceptions among the soils tested were few, namely Nos. 27, 33, 37 and 43, all of which were high in organic matter. These exceptions are apparently due to an abnormally high titration value or to an inhibitive effect, either of which may be associated with the organic material. It is hoped that additional studies of the reaction may throw further light upon the mechanism of corrosion and the properties of soils.

PLANT ECOLOGY.—*Acidity relations of the* Sarracenias.[1] EDGAR T. WHERRY, Bureau of Chemistry and Soils.

So far as now known, the genus *Sarracenia* comprizes eight species, and a number of hybrids, growing mostly in acid bogs and other moist places in eastern North America. In the course of studies of soil reaction, many observations have been made upon members of this genus, which seem worth placing on record here. Some of my data on the reactions of the liquid in the hollow leaves or "pitchers" were sent to Dr. Joseph S. Hepburn for inclusion in the monograph on the biochemistry of these plants by himself and associates,[2] but considerable additional material is now published for the first time. Recent discoveries have made it possible to describe the ranges of the individual species more fully than heretofore, although much more collecting needs to be done to delimit them accurately.

The technical nomenclature used is essentially that of Macfarlane,[3] although one new species is described, one new hybrid announced, and one new combination proposed. The distinctions between the species are brought out in the accompanying key, in which they are arranged in the order of increasing stature.

KEY TO THE SPECIES OF SARRACENIA

Leaves decumbent.
  Orifice lateral, small; petals dark red.......................*S. psittacina*
  Orifice terminal, large.
    Petals dark red....................................*S. purpurea*
    Petals yellow...........................*S. purpurea heterophylla*
Leaves erect or essentially so.
  Orifice closely covered by the arched hood; petals yellow........*S. minor*
  Orifice not closely covered by the hood.
    Hood small, its sides not reflexed; petals dark red............*S. rubra.*
    Hood large, its sides more or less reflexed.
      Reflexing of hood-sides not conspicuous.
        Petals cream-colored..............................*S. sledgei.*
        Petals dark red..................................*S. jonesii.*
      Reflexing of hood-sides conspicuous.
        Hood yellow-green, more or less marked with red; petals yellow *S. flava.*
        Hood mottled green and white, and strongly red veined; petals red...................................*S. drummondii.*

[1] Received September 10, 1929.

[2] J. S. Hepburn, E. Q. St. John, and F. M. Jones. *The Biochemistry of the American Pitcher-Plants*. Trans. Wagner Free Inst. Sci. 11: 1–95. 1927.

[3] J. M. Macfarlane. *Sarraceniaceae,* in Engler's Pflanzenreich, 4–110. 1908.

Reactions will be stated in the active acidity and alkalinity terms already explained elsewhere,[4] their significance being as follows:

	Act. acidity	pH		Act. alk.	pH
Superacid..........	8000–1000	3.1–4.0	Neutral............	Zero	7.0
Mediacid...........	800– 100	4.1–5.0	Minimalkaline.....	0.5– 8	7.1–7.9
Subacid....	80– 10	5.1–6.0	Subalkaline........	10 –80	8.0–8.9
Minimacid.........	8– 0.5	6.1–6.9			

S. PSITTACINA Michaux. PARROT PITCHERPLANT

This pitcherplant occurs practically throughout southern Georgia and northern Florida, but has not been observed south of latitude 30°; westward it reaches southeastern Louisiana. Its leaves are usually partly buried in peat, and tests of the soil reaction at some ten localities have shown active acidity 200 to 500, optimum 300, so that the species is to be classed as mediacid in preference.

The pitchers of this species are usually essentially free from liquor, but by introducing a little distilled water, a solution was obtained which showed an active acidity of 300, at all five different localities where this was tried.

S. PURPUREA L. SIDESADDLE PITCHERPLANT

This most widespread species of pitcherplant ranges from northwestern Florida to southern Mississippi, north to Newfoundland and to Manitoba, Canada, growing both in sphagnum bogs and in moist mineral soil. Several hundred soil tests have been made upon it, at about fifty localities, and in the majority of cases the reaction has proved to be mediacid, an active acidity of 300 being especially frequent. At a few places on the coast of Maine superacidity was observed, the reaction reaching as high as active acidity 3,000. In the vicinity of the Great Lakes, however, very different reaction-relations are shown, as discussed in subsequent paragraphs.

A short distance northeast of Junius, Seneca County, New York, there is a series of ponds and bogs, in some of which the water is strongly alkaline, and deposits a precipitate of calcium carbonate, known as marl, on the bottom, while in others the water is acid enough to permit the growth of sphagnum moss, which produces mediacid reactions. As usual, the latter habitat supports numerous thriving plants of *Sarracenia purpurea*, but quite unexpectedly the marl areas

[4] *A new method of stating hydrogen-ion (hydrion) concentration.* Bull. Wagner Free Inst. Sci., 2: 59. 1927; and Am. J. Pharm. 99: 342. 1927.

proved to be occupied by the same species. It grows in part on hummocks of decaying vegetable matter, which, extending above the water, attain a certain degree of acidity; but many individuals are rooted directly in the marl. On testing, the humus-rich marl scraped from the plant's roots showed active alkalinity 2 to zero, the reaction being thus minimalkaline to neutral. Essentially the same results have been obtained at three different seasons, late April, before plant growth had actively started; mid-June, when the pitcherplants were in full bloom; and mid-August, when they had gone to seed.

A visit during mid-June to a point on the east shore of Lake Huron, known as Sauble Beach, in Ontario at about latitude 44° 30′, resulted in the finding of another occurrence of this plant under non-acid conditions. The lake water is subalkaline, and damp hollows between small sand dunes are essentially neutral; *Sarracenia purpurea* is abundant in these hollows.

A third locality of non-acid reaction is a bog lying north of Mineral Spring Station, Porter County, Indiana, below the southern end of Lake Michigan. The open water is distinctly alkaline, showing active alkalinity 20 when tested in midwinter, and 10 in early June. Here the *Sarracenia* grows, it is true, in hummocks of decaying vegetation, but these are thoroughly impregnated with the water and thereby prevented from becoming particularly acid, tests of the soil at the plant roots showing active alkalinity 3 to active acidity 3, or closely circumneutral reactions.

The most reasonable interpretation of these facts is as follows: Pitcherplants, having developed a means of obtaining nitrogen, phosphorus, and other essential elements through digestion of insects which drown in the pitcher liquor, are able to grow in soils in which the content of these elements, in available form, is low. Nitrogen determinations on the soils of acid and circumneutral bogs near Junius, New York, showed between 2 and 3 per cent in both types, but in neither could any nitrates or ammonia be detected, indicating this element to be relatively unavailable to plants growing there. In the presence of large amounts of available nutrients, on the other hand, these physiologically peculiar plants are unable to thrive.

It is to be inferred, then, that *Sarracenia purpurea* grows commonly in acid bogs not because it requires highly acid soil, but because in such habitats the nutrient elements are available in amounts too small to affect it unfavorably. Whenever its seeds reach circumneutral bogs where these elements are unavailable, colonies can also develop. The reason why this species is so rarely found in the latter type of

habitat is not that the neutral reaction is unfavorable, but because in circumneutral soils nutrient elements are usually available in such quantities that injury occurs.

In the course of these studies a watch was kept for the yellow-flowered and green-leaved plant listed in current botanical manuals as *S. purpurea* variety *heterophylla*, and a typical clump of it was found on a hummock at the margin of a marl pond near Junius, New York. The reaction here was subacid, active acidity 30, but the color had no connection with this, for normal red-flowered and mottled-leaved plants were abundant on adjacent hummocks of like acidity. It seems evident, from the occurrence of the yellow flowers and green leaves on rare isolated individuals in the midst of numerous normal plants, that those individuals represent not really a variety, but a mutant lacking a factor for red coloration, affecting both petals and foliage. This situation should be recognized in the nomenclature, and a new combination is accordingly proposed here:

Sarracenia purpurea mut. **heterophylla** (Eaton) Wherry, comb. nov.
S. heterophylla Eaton. YELLOW SIDESADDLE PITCHERPLANT.

Purple pigment lacking from petals and foliage, the former correspondingly yellow, the latter green without mottling.

Several hundred reaction tests have also been made of the liquor in the pitchers of this species, and this proves to vary as much as do the soils, although no correlation can be recognized between them. The liquor-reaction has been found to range from low superacid, active acidity 1,000, to low subalkaline, active alkalinity 10. As the liquor in this species represents largely rain water, which is normally weakly acid owing to the presence of dissolved carbon dioxide and traces of salts, the possible sources of the higher acidities and of the alkalinities require consideration. In some cases, especially when the pitchers are buried nearly to the orifice in peat, splashing in of bog-water may be responsible, but even in deeply set pitchers reaction-values widely different from those of the surrounding waters have been observed. The dripping in of rain water which has trickled over the foliage of overhanging trees and shrubs may account for special values occasionally, although equally wide variations in the liquor-reaction have been noted in plants growing in the open. The alkalinity in some pitchers gave indication of being due to the decay of insects which had entered in greater abundance than usual, a distinct ammoniacal odor being perceptible; on the other hand, high acidity seemed in some instances to be connected with the presence of numer-

ous formic acid-secreting ants. That the plants themselves have no means of keeping the liquor-reaction constant is suggested by the fact that the several pitchers on a single individual often vary widely in this respect. The most extreme case observed was in a plant growing along a stream in New Mill Meadow, Mount Desert Island, Maine, where the liquor in an old leaf (containing many dead ants) had active acidity 300, while the next-adjoining younger one (with few insects of any kind) showed active alkalinity 10. The variability of reaction of pitcher-liquor in this and other species would make an interesting subject for further investigation.

SARRACENIA MINOR Walter. HOODED PITCHERPLANT

This species, sometimes known by the name *S. variolaris* Michaux, has the southermost range of all the pitcherplants, having been observed to grow as far down as Osceola County, Florida, at about latitude 28°, and to extend from there to southeasternmost North Carolina and to southern Mississippi. Its favored habitats appear to be damp meadows and low places in pine lands, where it is usually rooted in mineral soil containing more or less admixture of peat. About 25 measurements of its soil reaction have been made at five different localities, and the least acidity found was low subacid, active acidity 30, the greatest high mediacid, active acidity 500, and the usual value around active acidity 300. It is thus to be classed as a mediacid-soil plant. The reaction of the liquor in the pitchers proved to range from active acidity 100 to 1000, although 300 is the most frequent.

In the monograph cited, Macfarlane recorded the existence of hybrids of this species with *S. flava, S. psittacina,* and *S. purpurea.* The recognition of a new one, with *S. rubra,* may here be announced.

S. minor × rubra Wherry, hybr. nov. CANDLER PITCHERPLANT

Hybrid nature inferred from the following features: Leaves intermediate in size between those of the two presumable parents; degree of arching of hood also intermediate; translucent patches in back of hood distinct, though much less so than in *S. minor;* flowers between those of the parent species in respect to color and fragrance: petals 3 cm. long, dull red (near Ridgway's Pompeian red, 3'i) grading into yellow around the margin; odor sweet but faint. Liquor reaction found to be active acidity 300, like the two parent species.

This was discovered in a damp hollow a short distance west of Lott's Creek, about 12 kilometers ($7\frac{1}{2}$ miles) northeast of Metter, Candler County, Georgia, in June, 1923, and may accordingly be termed the

Candler Pitcherplant. The soil reaction there is mediacid, active acidity 300, and besides the two parents, *S. flava*, *S. psittacina*, and one or two previously known hybrids occur. The single plant found has been grown ever since by Dr. Frederick V. Coville in the U. S. Department of Agriculture greenhouses.

Sarracenia rubra Walter. Sweet Pitcherplant

The common name of this species refers to one of its most distinctive features, the delicious grape-blossom scent of its rather small maroon-red petalled flowers. It is apparently unknown in Florida, but is common in the Coastal Plain (and occasional in adjacent Piedmont) from southern Georgia nearly to Alabama and to Cumberland County, North Carolina; reports elsewhere seem to refer to the plant here separated as a distinct species under the name *Sarracenia jonesii*.

About 25 measurements of the soil reaction of this pitcherplant have been made throughout the range described, and it has been found to be invariably strongly acid, from active acidity 100 to 600, most frequently 300, indicating a mediacid preference. The pitchers rarely contain enough liquor for reaction determination, but upon adding distilled water, material dissolves and shows an active acidity of 300 in all cases tested.

Sarracenia sledgei Macfarlane. Pale Pitcherplant

The two species keyed out on the basis of having large hoods with but inconspicuously reflexed sides have been much misunderstood in the past. For many years the present one was mistaken for *S. flava*, and its distinctness was not recognized until pointed out by Professor Macfarlane in 1908. Besides the difference in hood-shape the two are dissimilar in various other respects; *S. sledgei* is notably smaller in stature and has sweet-scented flowers with creamy white petals, in contrast to the ill-scented yellow flowers of its relative. There are also technical distinctions in the capsules and seeds. Pale pitcherplant ranges from the Alabama River in southwestern Alabama to Smith County, Texas, longitude 95½°, and northward nearly to latitude 33°. Its favored habitat is a damp hollow in pine woods, where the soil is a blackish peaty sand. The soil reaction has been measured at five localities, and found to be mostly high mediacid, active acidity 400, but one locality in westernmost Alabama showed it to be superacid, active acidity 1250. It is to be classed as preferring high mediacid soils.

Hepburn and Jones[5] found the reaction of the pitcher-liquor of this species at Biloxi, Mississippi, to range from active alkalinity 3 to active acidity 10, a composite sample from 40 open pitchers being neutral. My tests at various localities gave similar results; the liquor in two unopened leaves was neutral and low minimacid (active acidity 2), respectively, while in a number of mature ones the highest acidity noted was 10 and the most frequent about 5. Quite unlike the related *S. flava*, then, this pitcherplant secretes essentially neutral material into its pitchers.

Sarracenia jonesii Wherry, sp. nov. MOUNTAIN PITCHERPLANT

In the course of field work in the Blue Ridge of North Carolina, in the summer of 1920, pitcherplants with leaves resembling those of *S. sledgei* were observed to be present in occasional boggy meadows, but were passed over as probably representing an upland form of *S. flava*. In late May, 1927, however, Harry W. Trudell and the writer visited one of their localities, a boggy stream-valley south of Flat Rock Station, in Henderson County, and found this plant in bloom. Much to our surprise the petals proved to be not yellow nor cream-colored at all, but dark red. It could not be *S. rubra*, however, for its leaves were taller, more expanded upward, and provided with larger hoods having more distinctly reflexed margins; the scapes did not markedly exceed the leaves; and the petals and capsules were twice as large as in that species.

On mentioning this to Frank M. Jones, the entomologist of Wilmington, Delaware, who has made such interesting studies of the relations of insects to pitcherplants, and who collaborated with Dr. Hepburn in the monograph on the biochemistry of these plants already referred to, he told me of having observed the same puzzling species in Western Florida. His specimens proved to have the characters of the North Carolina mountain plant; and on looking through the *Sarracenias* in the U. S. National Herbarium it was found that the same thing had been collected at a number of places. When only leaves were represented it had been labelled or annotated *S. catesbaei* or *S. flava*, and when well preserved flowers were included, *S. rubra* (sometimes marked as an anomalous form). Being distinct, however, from *S. rubra* in similar respects to those which led Professor Macfarlane to segregate *S. sledgei* from *S. flava*, it may well be assigned independent status, and I take pleasure in dedicating it to Mr. Jones, with the following characterization:

[5] Trans. Wagner Free Inst. Sci. 11: 71. 1927.

Principal leaves erect, distinctly expanded upward, reaching a height of 75 cm. or possibly more, green with rather inconspicuous red veinings; hood ovate, curving high over the orifice, its sides distinctly but not strongly reflexed. Scapes up to 50 cm. tall; flowers delicately sweet-scented; petals dark red (Ridgway's ox-blood red, 1k, to almost maroon, 3m), up to 3 cm. wide and to 5 cm. long; capsule about 15 mm. in diameter.

Type locality, moist meadow 1.5 mile (2.5 km.) south of Flat Rock Station, Henderson County, North Carolina; type specimen collected by E. T. Wherry, May 13, 1929, deposited in the U. S. National Herbarium, No. 1,438,266. Other collections regarded as representing the same species are:

NORTH CAROLINA: Hendersonville, June, 1881, *Canby;* Muddy Creek, Henderson County, Aug. 21, 1881, *J. Donnell Smith;* Biltmore Estate, 1895, *Boynton;* Baltimore, May 24, 1897, *Biltmore Herbarium* 3374a.

FLORIDA: Walton Co., *Curtiss* 107; De Funiak Springs, April 30, 1898, *Curtiss* 6387.

ALABAMA: Mobile, April 14, 1892, *Mohr;* Fowl River, April 23, 1893, *Mohr.* Jasmine, April 28, 1921, *Harper* 172.

MISSISSIPPI: Waynesboro, August 8, 1896, *Pollard* 1231.

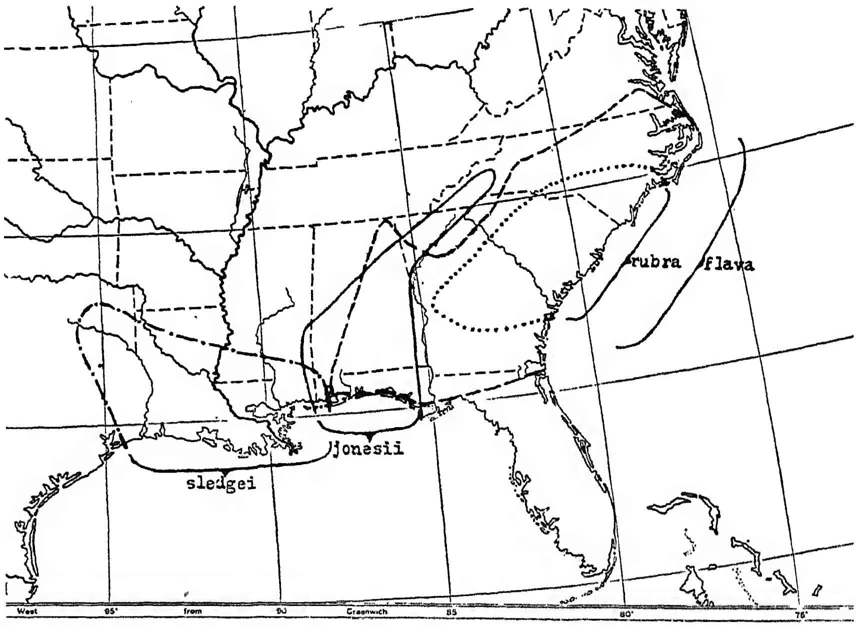
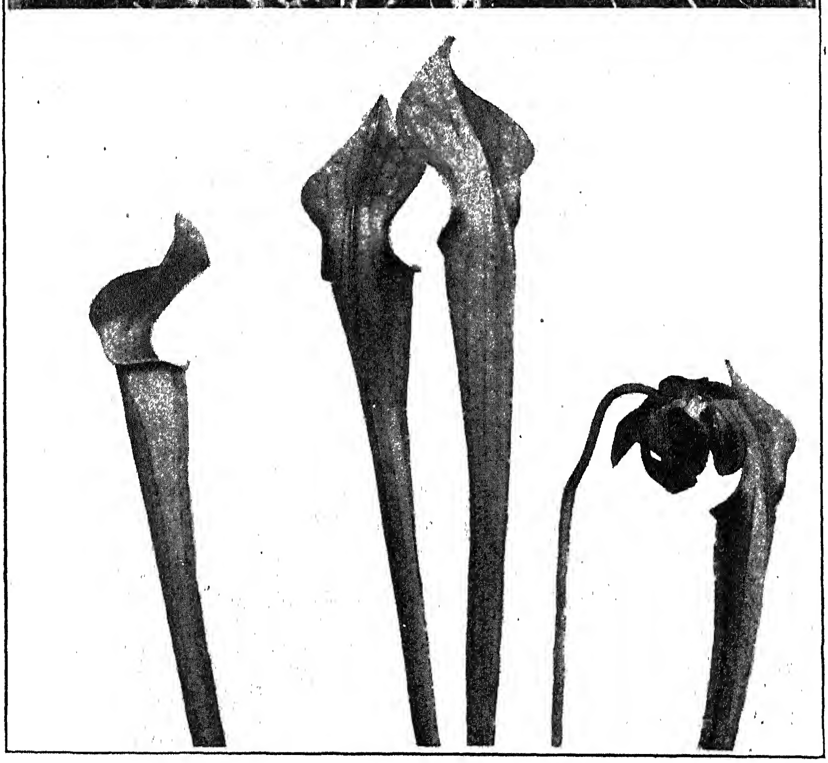


FIG. 1.—Distribution of *Sarracenia jonesii* and related species

The range of this species, then, so far as known, is from Walton Co., Florida to easternmost Mississippi and to Buncombe Co., North Carolina. In the latter region it reaches an altitude of at least 2150 feet (650 meters), high enough for winter temperatures far below freezing, and is thus the hardiest species next to *S. purpurea.* In Figure 1 this range is shown in comparison with those of related



species, all boundaries being approximations, subject to correction as future collecting brings new localities to light. *S. jonesii* is here termed Mountain Pitcherplant because of being the only one of this group of species which pushes far up into the mountains.

The soils at the type locality vary rather widely in reaction, from active acidity 5 to 500, but this plant appears to thrive best at about 50, so it is to be classed as of subacid soil preference. The small amount of liquid in eight pitchers, part of them unopened, showed an active acidity of 30 to 100.

On page 387 are shown two views of *Sarracenia jonesii*, the upper having been taken at the type locality May 13, 1929, the lower in the greenhouse of the U. S. Department of Agriculture, where it is being cultivated in acid soils, along with the other members of the genus, by Dr. Frederick V. Coville. The characters which serve to differentiate it from *S. rubra*, marked expansion of leaves upwards, relatively large hood with somewhat reflexed margins, and large flowers on scapes not markedly exceeding the leaves at blooming time, are well brought out.

S. FLAVA L. TRUMPET PITCHERPLANT

The range of the Trumpet Pitcherplant, a species so well characterized by its large yellow-petalled flowers with a pungent feline odor, is from the Suwanee River in Florida to the Alabama River, and thence northward to Jackson, the northeasternmost county in Alabama, and to Prince George County, Virginia. It has been also cultivated outdoors for years on Long Island, New York, so is to be classed as approaching *S. jonesii* in hardiness. Its favored habitats are damp meadows and low places in open pine woods, in sandy or clayey soil. Tests of its soils have shown rather uniformly high acidity, from active acidity 50 to 1000, with 300 the most frequent, making it a mediacid soil plant.

The pitcher-liquor in this species is consistently strongly acid. Hepburn and Jones found active acidity 100 to 3000 in 5 mature pitchers, and I have observed 30 to 500, but most frequently 300, in more than 30 tests at some ten different localities. Three unopened leaves from plants growing near Quincy, Florida, showed active acidity 500, 600, and 800 respectively. In this respect it contrasts sharply with its relative, *S. sledgei*.

The Catesby Pitcherplant, a hybrid of *S. flava* with *S. purpurea* (*S. catesbaei* Ell.) was studied in a swamp west of Quincy, the soil proving to be low mediacid, active acidity 200, and the liquor in two mature pitchers high minimacid, acidity 5 and 6. In these respects the hybrid resembled the second named parent more than the first.

S. DRUMMONDII Croom. DRUMMOND PITCHERPLANT

This largest and showiest of the *Sarracenias* is well distinguished from all others by the mottling and veining of the upper parts of the leaves with white, green, and red. There has been some misunderstanding about its range, for in Miss Lounsberry's book on southern plants,[6] it is stated to be especially common between Aiken, South Carolina, and Richmond County, North Carolina. Actually, only *S. rubra* and *flava* are common there, and the easternmost authenticated record of *S. drummondii* is in Sumter County, Georgia, longitude 84°. In Florida it occurs only toward the western end, although like several other species it extends into southern Mississippi. Reaction measurements have been made on this species at two localities, in the general vicinity of Milton, Santa Rosa County, Florida. The soil proved to have active acidity 150 to 400, averaging 250, so that like the next preceding it is a mediacid soil plant.

Hepburn and Jones recorded measurements on the liquor in 5 open pitchers of this species near Freeport, in the same part of Florida, three of them showing active acidity 3, the other two active alkalinity 3. My tests in a swamp east of Milton showed the liquid in two unopened pitchers to be alkaline, active alkalinity 10 and 30, respectively, the latter being the highest alkalinity as yet observed in any of the species. A number of open pitchers ranged from neutral to active acidity 30, although the majority were but minimacid. In spite of its growth in acid soils, then, this plant evidently secretes alkaline substances into its leaves, which prevent the acidity rising as high as in most of the others. It is interesting to note that *S. sledgei*, which overlaps *S. drummondii* in range from the west, is also characterized by circumneutral pitcher-liquor.

In conclusion, the reactions of the soils and pitcher-liquors in the eight species of pitcher-plants may be tabulated to bring out their relations graphically. A light-face letter X indicates that a given reaction has been observed, a bold-face **X** that the designated reaction appears to be most frequent.

[6] Alice Lounsberry. *Southern Wild Flowers and Trees*. 206. 1901.

TABLE 1. SOIL REACTIONS OF THE SARRACENIAS

Species	superacid	mediacid	subacid	minim-acid	neutral	minim-alk.	subalk.
psittacina	—	X	—	—	—	—	—
purpurea	X	X	X	X	X	X	—
minor	—	X	X	—	—	—	—
rubra	—	X	—	—	—	—	—
sledgei	X	X	—	—	—	—	—
jonesii	—	X	X	X	—	—	—
flava	X	X	X	—	—	—	—
drummondii	—	X	—	—	—	—	—

TABLE 2. PITCHER-LIQUOR REACTIONS OF THE SARRACENIAS

Species	superacid	mediacid	subacid	minim-acid	neutral	minim-alk.	subalk.
psittacina	—	X	—	—	—	—	—
purpurea	X	X	X	X	X	X	X
minor	X	X	—	—	—	—	—
rubra	—	X	—	—	—	—	—
sledgei	—	—	X	X	X	X	—
jonesii	—	X	X	—	—	—	—
flava	X	X	X	—	—	—	—
drummondii	—	—	X	X	X	X	X

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

ENTOMOLOGICAL SOCIETY

408TH MEETING

The 408th regular meeting of the Entomological Society of Washington was held at 8 p.m., Thursday, February 7, 1929, in Room 43 of the New Building of the U. S. National Museum. Mr. J. E. GRAF, President, presided. There were present 30 members and 21 visitors. Doctor HOWARD expressed his regret at the small attendance reported for the previous meeting and urged that there be no repetition of such lapses at future important meetings in which special tribute would be rendered to visitors.

The Executive Committee recommended for membership the following new candidate who was duly elected on vote of the Society: Mrs. J. B. REESIDE, Jr., of Hyattsville, Maryland.

Doctor HOWARD referred to the recent death of Dr. H. G. DYAR and read the following resolutions which by vote of the Society were spread upon its minutes:

The Entomological Society of Washington records with deep regret the death of Dr. HARRISON G. DYAR on January 21, 1929. Doctor DYAR had worked in the U. S. National Museum for thirty-one years. He had been Custodian of the Lepidoptera, and at one time Assistant Curator of the Division of Insects; also for a time editor of the Proceedings of this Society.

Among his many papers, he published a classification of Lepidopterous larvae (1894), a great list (or catalog) of the North American Lepidoptera (1902) and very many other papers concerning Lepidoptera. Becoming interested in the Culicidae in 1903, he was coauthor of the four-volume Monograph of the Mosquitoes of North and Central America and the West Indies (1917–18), and shortly before his death completed and published a large volume entitled "The Mosquitoes of the Americas." He also founded and edited the monthly journal known as *Insecutor Inscitiae Menstruus*, of which fourteen volumes were published. He was a tireless worker, and his name will always be prominent in the annals of American entomology.

The first paper on the regular program was the Annual Address of the retiring president, Mr. S. A. ROHWER, and was entitled "Economic Aspects of Taxonomic Entomology." This paper will be published in full in an early number of the Proceedings of the Society. Comment on this paper was made by GRAF, HOWARD, BAKER, ALDRICH, GAHAN, CORY, BLISS, and CUSHMAN.

The next paper on the program was presented by Mr. W. H. WHITE, and was entitled "The A. B. C. of truck crop entomology." The principal object in presenting this paper was to bring to the attention of the Society something of the nature of the work which is being carried on with the Office of Visual Education of the Extension Service of the Department. A considerable number of lantern slides, showing the various manners in which insects attack vegetables together with insecticide appliance, were shown and explained. Comment on this paper was made by BAKER and WEBB.

Brief remarks were made on invitation by Dr. C. I. BLISS, of the Bureau of Entomology, regarding the recently established U. S. Entomological Laboratory in Mexico City in coöperation with the Mexican Government for the study of the Mexican fruit fly. Emphasis is being placed on investigation of the various climatic factors, including atmospheric pressure at varying altitudes. Data also is being secured on soil conditions, host plants, and other like subdivisions of the investigation, in the hope that the information obtained in Mexico may be useful in predicting the possibilities of survival of the fly should it appear in citrus regions of the United States and for control work in that contingency.

Comment on the remarks of Doctor BLISS were made by BAKER, HOWARD, and GRAF.

409TH MEETING

The 409th regular meeting was held at 8 p.m., Thursday, March 7, in Room 43 of the New Building of the U. S. National Museum. Mr. J. E. GRAF, President, presided. There were present 27 members and 24 visitors.

The Corresponding Secretary-Treasurer, Mr. ROHWER, reported briefly on a meeting of the Executive Committee of the Society on February 27th at which consideration was given to a suggested policy of participation in formulation of programs with the Washington Academy of Sciences, and in which favorable action was taken in connection with exchanges of our Proceedings with various foreign organizations, and in which certain other minor matters were given attention.

The Executive Committee recommended for membership the following new candidate who was duly elected on vote of the Society: Miss MABEL COLCORD, Librarian of the U. S. Bureau of Entomology, Washington, D. C.

The first paper on the regular program was by Doctor WILLIAM SCHAUS and was entitled "Collecting Butterflies in the American Tropics."

In his talk to the members of the Society, Doctor SCHAUS took them in spirit from Vera Cruz, Mexico, to Jalapa, then to the table-lands by way of Perote and around the Volcano of Orizaba down to the temperate zone at Cordoba and across country by the way of Huatusco back to Jalapa; subsequently by Las Vigas in a northeasterly direction to Tuxpan, returning by Misantla to his headquarters, relating many experiences and giving descriptions of the country. Subsequently trips were made to the Volcano Popocatepetl and on the west coast to Cuernavaca and Uruapan, also to the Isthmus of Tehuantepec. In Guatemala, headquarters were made at Cayuga and repeated excursions were made along the railway, also to the city, and on the Pacific slope from Escuintla to Mazatenango and Retalhulcu with side trips to the slopes of the Volcano of Santa Maria, also on the eastern side of the country to numerous points in Verapaz. In Costa Rica the country was well covered by repeated trips on both the Caribbean and Pacific sides, and this at all seasons of the year and during a period of three years. Some time was spent on the Volcanos of Poas and Turrialba, this at different seasons of the year, the collecting depending upon the amount of rainfall and sunshine. For night work nothing was quite equal to an electric arc light. (Author's abstract.)

This paper was discussed by GRAF, EWING, CLARK, and BAKER.

One of our visitors, Doctor D. M. DELONG, Ohio State University, Columbus, Ohio, on invitation, addressed the Society briefly on some experimental work performed by him the past summer on the possible uses of Bordeaux mixture as an insecticide, with special reference to leafhopper control. Some details were presented on the different combinations and variations, and on the equipment employed, and a brief summary was given of general results obtained.

Mr. G. G. BECKER, Plant Quarantine and Control Administration, on invitation also greeted the Society and expressed pleasure at being with us.

Mr. ROHWER presented a brief note on the birch leaf-miner, described by MacGillivary in 1909 as *Phlebatrophia mathesoni*. This note will be published in full in an early number of the Proceedings of our Society.

Mr. BISHOPP reported that an appropriation of $12,000 in the recently approved Deficiency Bill had been secured for investigation of certain species of buzz gnats in the genus *Hippelates* in portions of southern California. He discussed injury by this pest and cited instances of its serious character. These remarks were discussed by BAKER.

410TH MEETING

The 410th regular meeting was held at 8 P.M. Thursday, April 4, in Room 43 of the new building of the U. S. National Museum. Mr. J. E. GRAF, President, presided. There were present 24 members and 8 visitors.

The Executive Committee recommended for membership the following new candidates who were duly elected on vote of the Society: CHARLES H. MARTIN, H. S. PETERS, F. M. WADLEY, G. G. BECKER, O. E. GAHM, J. E. WALTER.

The Corresponding Secretary-Treasurer, Mr. ROHWER, reported that Dr. T. E. SNYDER, due to prolonged absence from the city, had resigned from the Program Committee, and that Dr. HAROLD MORRISON had been appointed to take his place, the other members of the Committee now being Dr. C. A. WEIGLE, and Dr. N. E. MCINDOO.

The first paper on the regular program was presented by Dr. F. M. WADLEY, and was entitled "On the nature of injury of *Toxoptera graminum* to its host plants."

"*Toxoptera graminum* is more injurious in proportion to its numbers than other common grain aphids. Its feeding causes pale spots with red centers on the leaves of its food plants. Injury invariably followed feeding and was proportional to the amount of feeding. Paleness was apparently caused by destruction of chlorophyll, while the red spots were due to reddening of the leaf cell nuclei. A water extract of *Toxoptera* slowly decolorized a solution of refined chlorophyll. On heating, the extract lost this power. It seems likely that an enzyme is the cause of the destruction of chlorophyll." (Author's abstract.)

This paper was discussed by WALTON, BAKER, GAHAN, MORRISON, CORY, SNODGRASS, WOOD, and GRAF.

The second paper on the program was entitled "Host Relationships of the North American Chigger, *Trombicula irritans* (Riley)," by Dr. H. E. EWING of the Bureau of Entomology.

"Recent surveys made in some of the Middle Atlantic States of the possible hosts of *Trombicula irritans* (Riley) showed that it parasitized certain species of four classes of Vertebrata: Amphibia, Reptilia, Aves and Mammalia. Among the resistant vertebrates (non hosts) were pit-vipers, some turtles, insectivors and most rodents. Susceptible hosts are of two kinds: Those that are susceptible at all active stages of their life history and those that are susceptible only at certain stages, as is the case of Fowler's toad. This toad (*Bufo fowleri*) is infested only when the individuals are very young, yet tailless. Many vertebrates occurring in chigger-infested areas, during the chigger season, are not attacked because their habits keep them in situations not reached by the active larvae. Water snakes, tree-frequenting birds and mammals living in overflow land are in this category." (Author's abstract.)

Dr. EWING's paper was discussed by WALTON, BAKER, GAHAN, MORRISON, CORY, SNODGRASS, WOOD, and GRAF.

Dr. P. W. CLAASSEN, of Cornell University, Ithaca, N.Y., on invitation made a few remarks more or less humorous in character relative to the subject matter of the previous speakers, and discussing some of his recent work in the vicinity of Ithaca on immature stages of Plecoptera. These observations were discussed briefly by ROHWER.

411TH MEETING

The 411th regular meeting was held at 8 P. M., Thursday, May 2nd, in Room 43 of the new building of the U. S. National Museum. Mr. J. E. GRAF, president, presided. There were present 46 members and 45 visitors.

There were no preliminary business matters for discussion, so attention was given at once to the main feature of the evening,—this consisting of an informal address by Dr. C. L. MARLATT on the Mediterranean fruit fly situation in Florida. In this address, Doctor MARLATT reviewed very briefly the status of the insect as a pest in other countries and the various official measures taken to intercept and keep it out of this country. He then discussed the recent finding of the pest in Florida and the events immediately following this, including his own recent trip to the Orlando and Gainesville territory and his personal observations on the injury and spread of the pest. A summary also was given of the organization of the cooperative exterminative work now being performed by Federal and State authorities, and a review was given of the events connected with the appropriation of Federal funds and assignment of State and other funds for the work. Maps of the area of

infestation and a number of slides were shown, the latter dealing with the injury, life history, and control of the pest.

Dr. MARLATT's paper was discussed by CLARK, MCINDOO, BACK, BECKER, PERRINE, and POOS.

Mr. ROHWER referred to the recent recurrence of the Mexican fruit worm in the Lower Rio Grande Valley of Texas, stating that it had been found in a few fruits at three different places within the Valley. Because of the delay in the ripening of grapefruit due to the unfavorable rainy season of the autumn, the shipping season had been extended one month and the fruit allowed to remain on the trees until the 30th of March. This extension of the shipping season left fruit susceptible of infestation by the fly on the trees a longer period, and may have been in part responsible for the recurrence of the insect. This emphasizes the continuing danger of a reinfestation and may even indicate that the insect has not been completely eradicated from the Valley. In any event, it emphasizes the need of continual vigilance in the enforcement of the quarantine regulations as originally planned.

J. S. WADE, *Recording Secretary.*

SCIENTIFIC NOTES AND NEWS

Dr. RAY S. BASSLER, of the U. S. National Museum, has returned from Prague, Czechoslovakia, where he has spent some time making casts of types of species of fossils described in Barrande's Système Silurien du Centre de la Bohème.

Dr. LYMAN F. KEBLER has resigned from the Office of Collaborative Investigations of the Food, Drug, and Insecticide Administration, U. S. Department of Agriculture, to become Medical Director of the Doctors' Essential Food Company and the Bowman Hotels Corporation, with offices in Washington, D. C.

Obituary

PETER A. YODER, Associate Technologist in Sugar-cane Investigations, Bureau of Plant Industry, U. S. Department of Agriculture, and a member of the ACADEMY, died on July 20 in Washington, D. C. He was born in Shipshewana, Indiana, August 21, 1867, and studied at Indiana University, receiving the degrees of A.B. in 1894 and A.M. in 1896. He took post-graduate work at the University of Chicago for a year, and then went to Göttingen, Germany, where he received the degree of Ph.D. in 1901. He taught in various high schools and colleges for several years, was Director of the Utah Experiment Station from 1905 to 1907, and research chemist at the Louisiana Sugar Experiment Station, 1908 to 1910. He entered the Bureau of Chemistry of the U. S. Department of Agriculture in 1910, and three years later was transferred to the position in the Bureau of Plant Industry which he held up to the time of his death. He was the author of a number of papers on various phases of organic chemistry, agronomy, and sugar technology, and in recent years was stationed at Cairo, Georgia, in charge of the Department of Agriculture's Sugar Plant Field Station, where he was engaged in investigating the production of cane sirup.

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MATHEMATICS.—*On Fermat's Last Theorem*, II.[1] VAL. MAR. SPUNAR, Chicago, Ill. (Communicated by EDGAR W. WOOLARD.)

In a previous communication[2] it has been shown that if x, y, z, be a solution in relatively prime integers, all different from zero, of

$$x^\lambda + y^\lambda = z^\lambda \qquad (2)$$

$x < y < z$, λ an odd prime $\geqslant 3$, and $xyz \not\equiv 0 (\text{mod } \lambda)$, then we have

$$x = \alpha\,\xi \quad \alpha^\lambda = z - y \quad \xi^\lambda = \frac{z^\lambda - y^\lambda}{z - y} \qquad (3)$$

$$y = \beta\,\eta \quad \beta^\lambda = z - x \quad \eta^\lambda = \frac{z^\lambda - x^\lambda}{z - x} \qquad (4)$$

$$z = \gamma\,\zeta \quad \gamma^\lambda = x + y \quad \zeta^\lambda = \frac{x^\lambda + y^\lambda}{x + y} \qquad (5)$$

in which α, β, γ, ξ, η, ζ, λ, are all relatively prime integers; and

$$\alpha + \beta = \gamma \pm \delta \qquad (19)$$

[1] Received February 19, 1929.

[2] THIS JOURNAL **18**: 389. 1928. The following typographical errors should be noted: Page 390, equation (4_3), for y read x; last line, for "relative primes," read "relatively prime." Page 391, last term of (9 *bis*), for z read ζ. Page 392, eq. (19), for Δ read M. Page 394, for $\xi < \eta < \zeta$, read $\xi > \eta > \zeta$; for $H = n/\xi$, read $H = \eta/\xi$. On page 395, eq. (25) should be numbered (35), and (26) should be (36); the first equation on page 395 should be (34), and the last (37); the next to the last equation on page 394 should be numbered (33); and on page 395, line seven, for "by (24) and (25)" read "by (24) and (35)."

i.e., $\gamma \neq \alpha + \beta$, where δ is some positive integer > 0. The following inequalities were also proved:

$$2\,\lambda^2 < \delta < \alpha < \beta < \gamma \quad \ldots\ldots (39)^{3}$$

$$\xi > \eta > \zeta \quad \ldots\ldots (40)$$

$$\lambda\,\alpha^{\lambda} < x \quad \ldots\ldots (35)$$

$$\alpha + \delta < 2\,\alpha \left(\frac{\eta}{\xi}\right)^{\lambda - 1} \quad \textit{if} \quad \alpha + \beta + \delta = \gamma \quad \ldots\ldots (33)$$

$$\xi^{\lambda} < \lambda\, z^{\lambda - 1} \quad \ldots\ldots (30)$$

$$\lambda\, x^{\lambda - 1} < \lambda\, y^{\lambda - 1} < \xi^{\lambda} \quad \ldots\ldots (34)$$

From (30) and (34)

$$\lambda\, y^{\lambda - 1} < \xi^{\lambda} < z^{\lambda - 1}\,\lambda \quad \ldots\ldots (41)$$

Also

$$\lambda\, x^{\lambda - 1} < \eta^{\lambda} < z^{\lambda - 1}\,\lambda \quad \ldots\ldots (42)$$

the proof that $\eta^{\lambda} > \lambda x^{\lambda-1}$ being similar to that of (30). Furthermore, putting

$$d = x + y - z \quad \ldots\ldots (9\ bis)$$

we have $d < x$, since $y - z$ is negative, and hence

$$d < x < y < z \quad \ldots\ldots (38)$$

Also, by pairing successive terms in the expansion of (5_3), $x < y$, λ odd, we see that

$$x^{\lambda - 1} < \zeta^{\lambda} < y^{\lambda - 1} \quad \ldots\ldots (43)$$

Now, writing (19) in the form

$$\gamma = \frac{\gamma^{\lambda}}{\gamma^{\lambda - 1}} = \alpha + \beta \pm \delta$$

[3] Abel's Theorem that $x^{\lambda} + y^{\lambda} = z^{\lambda}$ has no solution in integers if x, y, or z be prime was proved by E. Lucas; but Markoff, L'interméd. de math. **2**: 23. 1895, and **8**: 305. 1901, pointed out that Lucas' proof is incomplete, as the case $z = y + 1$, i.e., $\alpha = 1$, $x = \xi$, is not included. Markoff asked if it is possible for $(y + 1)^{\lambda} = x^{\lambda} + y^{\lambda}$; eq. (39) shows that this is impossible, for $\alpha \neq 1$ if $2\,\lambda^2 < \alpha$.

and substituting for γ from (5_2), we have by (3_1) and (4_1)

$$\alpha \xi + \beta \eta = \gamma^{\lambda - 1} (\alpha + \beta \pm \delta)$$

whence

$$\alpha (\gamma^{\lambda - 1} - \xi) + \beta (\gamma^{\lambda - 1} - \eta) \pm \delta \gamma^{\lambda - 1} = 0 \ldots\ldots (44)$$

If

$$\xi < \gamma^{\lambda - 1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (45)$$

then, by (40), $\eta < \gamma^{\lambda-1}$, and the ambiguous sign in (44) is negative; but if this sign be negative, then at least one of the other terms must be positive and therefore either $\eta < \xi < \gamma^{\lambda-1}$ as before, or else $\eta < \gamma^{\lambda-1} < \xi$. Similarly, if

$$\gamma^{\lambda - 1} < \xi \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (46)$$

then either $\eta < \gamma^{\lambda-1} < \xi$, in which case the sign remains ambiguous, or else $\gamma^{\lambda-1} < \eta < \xi$ when the sign must be positive; and if the sign be positive, we may have either $\gamma^{\lambda-1} < \eta < \xi$ or $\eta < \gamma^{\lambda-1} < \xi$. Altogether, there exist the following possibilities:

$$\eta < \xi < \gamma^{\lambda - 1} \quad \gamma = \alpha + \beta - \delta \ldots\ldots\ldots\ldots (\mathrm{A})$$

$$\eta < \gamma^{\lambda - 1} < \xi \quad \gamma = \alpha + \beta - \delta \ldots\ldots\ldots\ldots (\mathrm{B})$$

$$\eta < \gamma^{\lambda - 1} < \xi \quad \gamma = \alpha + \beta + \delta \ldots\ldots\ldots\ldots (\mathrm{C})$$

$$\gamma^{\lambda - 1} < \eta < \xi \quad \gamma = \alpha + \beta + \delta \ldots\ldots\ldots\ldots (\mathrm{D})$$

The inequality (45) is a *sufficient* condition that the ambiguous sign in (44) be negative, and hence that $\gamma = \alpha + \beta - \delta$, while (46) is a *necessary* condition that it be positive and $\gamma = \alpha + \beta + \delta$.

From (41) and (46), $\gamma^{\lambda(\lambda-1)} < z^{\lambda-1} \lambda$, whence $\gamma^{\lambda} < z \sqrt[\lambda-1]{\lambda}$ or, since $\gamma^{\lambda} = x + y = z + d$, $z + d < z \sqrt[\lambda-1]{\lambda}$, and therefore if $\gamma^{\lambda-1} < \xi$,

$$d < z \left(\sqrt[\lambda - 1]{\lambda} - 1\right) \ldots\ldots\ldots\ldots\ldots\ldots (47)$$

Subtracting α^{λ} from both members of (35), we get by (3_2) and (9 *bis*)

$$(\lambda - 1) \alpha^{\lambda} < d \ldots\ldots\ldots\ldots\ldots\ldots\ldots (48)$$

Adding $(\lambda - 1)d$ to both members of (48) gives

$$\frac{\lambda - 1}{\lambda} x < d \ldots\ldots\ldots\ldots\ldots\ldots\ldots (49)$$

Hence, by (47) and (49),

$$qx < z. \qquad (50)$$

in which

$$q \equiv \frac{\lambda - 1}{\lambda\left(\sqrt[\lambda-1]{\lambda} - 1\right)} \qquad (51)$$

Calculation shows that for every $\lambda > 5$, $q > 2$ (λ odd). Obviously, therefore, if $\gamma^{\lambda-1} < \xi$,

$$2\,x < z \qquad (52)$$

whence by (4_2)

$$x < \beta^{\lambda} \qquad (53)$$

from which by (38)

$$d < \beta^{\lambda} \qquad (54)$$

or by (9 *bis*)

$$y < 2\,\beta^{\lambda} \qquad (55)$$

Now, if $\alpha + \beta + \delta = \gamma$, we have by (33)

$$\xi < \eta\left(\frac{2\,\alpha}{\alpha + \delta}\right)^{\frac{1}{\lambda-1}} \qquad (56)$$

whence by (41)

$$\lambda\,y^{\lambda-1} < \xi^{\lambda} < \eta^{\lambda}\left(\frac{2\,\alpha}{\alpha + \delta}\right)^{\frac{\lambda}{\lambda-1}} \qquad (57)$$

Multiplying by y ($= \beta\eta$), we get from (55)

$$\lambda\,\beta^{\lambda} < y\left(\frac{2\,\alpha}{\alpha + \delta}\right)^{\frac{\lambda}{\lambda-1}} < 2\,\beta^{\lambda}\left(\frac{2\,\alpha}{\alpha + \delta}\right)^{\frac{\lambda}{\lambda-1}},$$

$$\lambda < 4\left(2^{\frac{1}{\lambda-1}}\right)\left(\frac{\alpha}{\alpha + \delta}\right)^{\frac{\lambda}{\lambda-1}}$$

which shows that if $\gamma^{\lambda-1} < \xi$, and $\gamma = \alpha + \beta + \delta$, then

$$\lambda < 4\sqrt[\lambda-1]{2} \qquad (58)$$

and it would then be impossible to have $\lambda > 3$. The relations (C) and (D) are therefore ruled out; and

$$\gamma \neq \alpha + \beta + \delta \ldots\ldots\ldots\ldots\ldots \text{(25 } bis\text{)}$$

By raising both members of (50) to the λth power and subtracting x^{λ}, we see that if $\gamma^{\lambda^{-1}} < \xi$,

$$(q^{\lambda} - 1)\, x^{\lambda} < y^{\lambda} \ldots\ldots\ldots\ldots\ldots\ldots \text{(59)}$$

Adding the positive quantity $(\gamma \;\; - 1)y^{\lambda}$, we get

$$(q^{\lambda} - 1)\, z^{\lambda} < q^{\lambda}\, y^{\lambda}$$

or

$$z < y \sqrt[\lambda]{1 + \frac{1}{q^{\lambda} - 1}}$$

and writing the absolutely convergent binomial series for the root in the form

$$\left(1 + \frac{1}{\lambda\,(q^{\lambda} - 1)}\right) + \frac{1}{\lambda}\left(\frac{1 - \lambda}{2\,\lambda}\right)\left(\frac{1}{q^{\lambda} - 1}\right)^2\left[1 + \frac{1 - 2\,\lambda}{3\,\lambda}\left(\frac{1}{q^{\lambda} - 1}\right)\right] +$$

$$\frac{1}{\lambda}\left(\frac{1 - \lambda}{2\,\lambda}\right)\left(\frac{1 - 2\,\lambda}{3\,\lambda}\right)\left(\frac{1 - 3\,\lambda}{4\,\lambda}\right)\left(\frac{1}{q^{\lambda} - 1}\right)^4\left[1 + \frac{1 - 4\,\lambda}{5\,\lambda}\left(\frac{1}{q^{\lambda} - 1}\right)\right] + \ldots$$

we see, $y < z$, $\lambda \geqslant 3$, that when $\gamma^{\lambda^{-1}} < \xi$,

$$1 < \frac{z}{y} < \left[1 + \frac{1}{\lambda\,(q^{\lambda} - 1)}\right] \ldots\ldots\ldots\ldots\ldots \text{(60)}$$

The extreme right member approaches the value unity so rapidly with increasing λ, however,[4] as to make the supposition $\gamma^{\lambda^{-1}} < \xi$ apparently untenable; this rules out relation (B).

[4] Dickson, Quar. Jour. Math. **40**: 27–45, 1908, proved Fermat's Theorem for $n < 7000$; and Beeger, Mess. Math. (2), **55**: 17–26, 1925, showed that $x^{\lambda} + y^{\lambda} + z^{\lambda} = 0$ has no solution in integers prime to λ for $\lambda < 14000$. For $\lambda = 7001$ (the next prime above 7000), $q > 769$, and $1 < z/y < 1 + 10^{-20209}$; for $\lambda = 14009$, $q > 1428$, and $1 < z/y < 1 + 10^{-45131}$. Again, from (30), (46), and (5_1), we have $\xi^{\lambda} < \lambda\, z^{\lambda-1} < \lambda\, \xi\, \zeta^{\lambda-1}$, or $\xi < \zeta \sqrt[\lambda-1]{\lambda}$; while by ($43_2$) and ($34_2$), $\lambda\, \zeta^{\lambda} < \lambda y^{\lambda-1} < \xi^{\lambda}$ or $\zeta \sqrt[\lambda]{\lambda} < \xi$; combining these two results, $\sqrt[\lambda]{\lambda} < \frac{\xi}{\zeta} < \sqrt[\lambda-1]{\lambda}$, or $1 < \dfrac{\xi}{\zeta \sqrt[\lambda]{\lambda}} < \sqrt[\lambda(\lambda-1)]{\lambda}$, where for $\lambda = 14009$, $\lambda\,(\lambda - 1) = 196,238,072$.

It may be noted that, by (60),

$$\alpha^\lambda \lambda (q^\lambda - 1) < y < z \quad \ldots\ldots\ldots\ldots\ldots\ldots (61)$$

If $2x < z$, then by (40), $2\alpha < \gamma\left(\frac{\zeta}{\xi}\right) < \gamma$, i.e., $2\alpha < \gamma$; it also follows from (46) that $\gamma^\lambda < \gamma\xi$, whence $x + y < x + (\gamma - \alpha)\ \xi$ or $(\alpha\ \xi =)\ x < y < \xi\ (\gamma - \alpha)$ or $2\alpha < \gamma$. If $2\alpha > \gamma$, then, multiplying by $\sqrt[\lambda]{\lambda}$, we get from (3_1), (5_1), and the result $\zeta\sqrt[\lambda]{\lambda} < \xi$, that $z\sqrt[\lambda]{\lambda} < 2x$ or $\frac{2x}{z} > \sqrt[\lambda]{\lambda} > 1$, whence $\gamma < 2\alpha$ only if $2x > z$, which in turn is possible, by (52), only if (45) is satisfied.

From (9 *bis*),

$$\left.\begin{aligned} \xi &= \alpha^{\lambda - 1} + \frac{d}{\alpha} \\ \eta &= \beta^{\lambda - 1} + \frac{d}{\beta} \\ \zeta &= \gamma^{\lambda - 1} - \frac{d}{\gamma} \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots (62)$$

Substituting (9 bis_2) for $\beta^{\lambda-1}$ in (41_1), we get $\lambda\eta^{\lambda-1}\left(\eta - \frac{d}{\beta}\right) < \xi^\lambda$ or $\lambda\eta^\lambda < \xi^\lambda + \frac{\lambda d}{\beta}\eta^{\lambda-1}$; whence, if $\xi^\lambda < \frac{\lambda d}{\beta}\eta^{\lambda-1}$, then $y < 2d$, while if $\xi^\lambda > \frac{\lambda d}{\beta}\eta^{\lambda-1}$ then $\lambda\eta^\lambda < 2\xi^\lambda$. In the same way, we find from (43_2) that either $\zeta^\lambda < \frac{d}{\beta}\eta^{\lambda-1}$ and $2\zeta^\lambda < \eta^\lambda$, or else $\zeta^\lambda > \frac{d}{\beta}\eta^{\lambda-1}$ and $2d < y$. From (30), $\xi^\lambda < \lambda z^{\lambda-1} = \lambda\zeta^{\lambda-1}\left(\zeta + \frac{d}{\gamma}\right)$ or, by (38), $\xi < \zeta\sqrt[\lambda]{2\lambda}$. If we suppose

$$\left.\begin{aligned} &\xi^\lambda > \frac{\lambda\, d}{\beta}\eta^{\lambda - 1},\ \lambda\,\eta^\lambda < 2\,\xi^{\lambda - 1} \\ &\zeta^\lambda > \frac{d}{\beta}\eta^{\lambda - 1},\ 2\,d < y \\ &\xi^\lambda < 2\,\lambda\,\zeta^\lambda \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots (63)$$

then from the last, and the second part of the first, of these equations, we get $\eta^\lambda < 4\zeta$; but from (2) and (38), $z^\lambda < 2y^\lambda$ or $\zeta^\lambda < \frac{2y^\lambda}{\gamma^\lambda}$; consequently, $\gamma^\lambda < 8\beta^\lambda$, and thus by ($3_2$) and ($4_2$), $7x < y < z$, or $2x < z$, and our supposition is not tenable if $z < 2x$. If, however, we suppose

$$\left.\begin{array}{l} \xi^\lambda < \frac{\lambda\, d}{\beta}\,\eta^{\lambda-1},\ y < 2\,d \\ \\ \zeta^\lambda < \frac{d}{\beta}\,\eta^{\lambda-1},\ 2\,\zeta^\lambda < \eta^\lambda \\ \\ \xi^\lambda < 2\,\lambda\,\zeta^\lambda \end{array}\right\} \dots\dots\dots\dots\dots\dots (64)$$

then, if $\xi < \gamma^{\lambda-1}$ and $z < 2x$, we see that if $y < 2d = \gamma^\lambda - \beta^\lambda - \alpha^\lambda$ then $\beta^\lambda < d$ and $\alpha^\lambda + \beta^\lambda < x < y < z$. By (39), $\delta < \alpha$; and in the first paper it has been shown that δ contains the factors 6 and λ^2; whence $6\lambda^2 < \alpha$, and

$$[2\ (6\ \lambda^2)^\lambda]^\lambda < [\alpha^\lambda + \beta^\lambda]^\lambda < z^\lambda = x^\lambda + y^\lambda \dots\dots\dots (65)$$

From the last, and the second part of the second, of these three equations, we get $\xi < \eta\ \sqrt[\lambda]{\lambda}$. By ($4_2$), ($5_1$), and (23), if $\gamma = \alpha + \beta - \delta$,

$$x + \beta^\lambda = z = (\alpha + \beta - \delta)\ \zeta \dots\dots\dots\dots (66)$$

$$\alpha\ (\xi - \zeta) = \beta\ (\zeta - \beta^{\lambda-1}) - \delta\ \zeta \dots\dots\dots\dots (67)$$

where, since $\zeta < \xi$, $\delta\zeta < \beta\ (\zeta - \beta^{\lambda-1})$,

$$\beta^{\lambda-1} < \zeta \dots\dots\dots\dots\dots\dots\dots\dots (68)$$

Collecting our results,

$$\alpha^{\lambda-1} < \beta^{\lambda-1} < \zeta < \eta < \xi < \gamma^{\lambda-1} \dots\dots\dots\dots (69)$$

Hence we have in general

$$\xi < \gamma^{\lambda-1},\ \gamma = \alpha + \beta - \delta \dots\dots\dots\dots\dots (70)$$

δ a positive integer.

In a later paper, the decomposition of α, β, γ, δ, into factors will be considered.

PHYSICS.—*The stratified settling of fine sediments.*[1] P. G. NUTTING, U. S. Geological Survey.

Muddy water settles either clear to a false bottom or cloudy to an indefinite bottom. Clear settling indicates impure water, either salts in solution or a second colloid in proper proportion, while cloudy settling is generally proof of very pure water. The water of a lake having a false bottom is certainly contaminated to some extent, however clear, but the water of a lake or river that remains turbid after days of settling is free from salts in solution, bacteria and organic colloids since these, if ever present, have all been fixed by excess clay colloids. Extremes of concentration, valency, ionization, adsorption, particle fineness, dissolved air and many other factors may vary the picture somewhat but the rough sketch is sufficient introduction to the subject of this paper.

The chemical literature bearing on the precipitation of colloids is very extensive and has been ably summarized in the well known works of Bancroft, Alexander, Svedberg, Freundlich, Weiser and others. Physicists however have done very little with their side of the problems involved in the precipitation of fine particles though few phenomena in physics are more fascinating or instructive than the play of these extremely gentle forces, very delicately balanced, with the minute but violent Brownian movement ever present.

Carl Barus, of this laboratory,[2] made many observations on stratified settling but considered only gravity, particle size and viscosity of fluid among the physical factors involved, ignoring upward diffusion under the Brownian movement. Einstein[3] developed a statistical theory of the Brownian movement which gave the equilibrium distribution of one size of particles suspended in a liquid but his equations are too cumbersome to deal with a wide range of sizes. Perrin[4] verified Einstein's theory of stable distribution by actual counting and measurement. Mendenhall and Mason[5] reached the conclusion that stratified settling is due to minute temperature differences causing weak convection currents—a conclusion not acceptable to many thoroughly familiar with the behavior of fine suspensions. This paper is to present a theory much simpler and more general than Einstein's,

[1] Published by permission of the Director, U. S. Geological Survey. Received Sept. 28, 1929.

[2] BARUS. U.S.G.S. Bull. 36. 1886.

[3] EINSTEIN. Ann. Physik **17**: 549. 1905.

[4] PERRIN. Comptes rend. **146**: 968. 1908.

[5] MENDENHALL and MASON. Proc. Nat. Acad. Sci. **9**: 199, 202. 1923.

which gives Perrin's law of distribution as a special case and even covers stratified settling quite adequately. It is incidental to a study of the physico-chemical relations between the three hydrous oxides, silica (acid), alumina (amphoteric), and ferric hydroxide (basic) and the bentonites and other clays.

Stratified suspensions are readily prepared with almost any kind of fine particles shaken up with distilled water. Should they settle clear at first, repeated washing and settling will eventually bring about a condition where finer material will be left behind in suspension. After an hour or two this begins to settle away from the surface leaving a still finer suspension above it. Eventually five or more sharply distinct layers may be in the process of settling at the same time. Barus (*l.c.* 1886) made precise measurements of the rates of fall of many of these layers. Hydrated alumina and ferric oxide, chemically prepared, both flocculate and settle clear after repeated washings but eventually yield and come down in cloudy layers. Sodium silicate, if very highly diluted, appears to hydrolyze and precipitate white particles of silica. Dialyzed iron, diluted with pure water, shows no tendency to settle even after years of standing, yet a very small amount of purified bentonite will bring it down in a thick floc.

In a mass of particles at the absolute temperature T, the thermal or kinetic (distending) pressure p outward due to molecular or Brownian movement is[6]

$$p = CJRT/M \text{ dynes/cm}^2 \tag{1}$$

when C is the concentration in grams/cc, $JR = 8.30 \times 10^7$ and M is molecular weight. For example, in a suspension containing 1 gram per liter of particles each consisting of 10,000 molecules each of molecular weight 100, the pressure at 300° absolute is 24.9 dynes/cm²—a very gentle pressure in comparison with the kinetic pressure in water, 1380×10^6 dynes/cm², on account of the size of the particles and the sluggishness of their movements.

The pull downward by gravity on such an aggregate of particles is

$$w = Ckg \text{ dynes/cc} \tag{2}$$

where $k = 1 - \rho_l/\rho_g$ $g = 980$ dynes/gram and ρ_l and ρ_g are the densities of liquid and of suspended grains.

The pressure gradient, dp/dz, depends on the ratio CT/M. If this is constant, the kinetic pressure is uniform and the gradient zero.

[6] NUTTING. This JOURNAL 19: 296. 1929.

In a true solution C and M are both constant. Even in a suspension of fine particles, CT/M may be constant if the concentration be proportional to size of particle, i.e., if the number of particles per cc is constant from top to bottom or throughout any given layer. In general an aggregate of particles will be in equilibrium distribution if the pressure gradient upward just equals the weight of suspended material in unit volume,

$$dp/dz = dw \tag{3}$$

or, by substitution from (1) and (2)

$$\frac{d \log (CT/M)}{dz} = \frac{Mkg}{JRT} \tag{4}$$

which is the most general equilibrium condition. In the special case of uniform mass of particle M and uniform temperature T, (4) r-e duces to d log $C/dz = Mkg/JRT$ which may be integrated giving Perrin's equation which may be written

$$\log (C/C_0) = Mkgz/JRT \tag{5}$$

where z is the depth measured downward from the surface and C_0 is the concentration at the surface.

In the numerical example cited above, 1 mg of suspended material per cc accounted for a kinetic pressure of 24.9 dynes/cm², the weight of that material, $Ckg = 0.56$ dynes/cm²/cm (taking $k = 0.4$) hence for a steady state, the kinetic pressure must increase downward about 2 per cent per cm of depth. Hence CT/M must so increase and since a 2 per cent increase in T or decrease in M is very unlikely, the burden lies chiefly on the concentration C.

If the pressure gradient in a suspension is greater than its immersed weight then it will diffuse upward to the surface, if less than that weight it will settle according to the generalized Stokes' Law with the velocity

$$v = \frac{2\, r^2\, \rho_g}{9\, \eta\, C} \left(Ckg - \frac{JRT}{M} \frac{dc}{dz} \right) \tag{6}$$

The expression bracketed is the resultant force acting on all the particles in unit volume. When the concentration gradient $dc/dz = 0$, (6) reduces to the ordinary form of Stokes' Law. It may be put in different forms by using the substitutions $C = mN$, $m = V\rho = M \times$ mass of hydrogen atom 1.66×10^{-24} gram.

From the form of (6) it is easily seen that the velocity of fall is very sensitive to size of particle. It may readily be zero or even negative (upward) for the smaller particles. As each size of particles falls, smaller particles are not only left behind but tend to diffuse upward. But there is a limit to this tendency to separate because it must cease when the concentration gradient dc/dz reaches a certain minimum or the particles fail to make contact. This appears to be the explanation of the sharp upper boundary of particles exceeding a certain size.

In pure water the ionization is too slight and the adsorbed ions too weak to interfere greatly with the diffusion and settling. In salt solutions the reverse is the case, adhesion between particles is promoted by strong adsorbed ions, and coagulation and settling are rapid. However such phenomena have been much discussed by chemists.

Dialyzed iron, diluted with pure water in a clean glass vessel, stays up indefinitely. At the top it can not escape while on the walls and bottom the kinetic pressure is reflected in full force by the clean glass. But if the bottom say is made of clean jelly (such as prepared bentonite), particles are adsorbed instead of reflected when they hit and the suspended iron is gradually taken up.

The effect of what appears to be direct light pressure I have frequently observed when a suspension of extremely fine particles is left for several days in a tube exposed to a strong horizontal light. A large proportion of the finer particles are driven along the light path and are found adhering to the wall where it intersects the light beam and not elsewhere.

The thermal effect to which Mendenhall and Mason (*l.c. ante*) attribute stratified settling appears to be but one of its minor causes. They found that stratification did not occur in a constant temperature room and that strata already formed in a lighted room disappeared when removed to a constant temperature room. I have been unable to confirm their conclusions in a single instance. I find that a properly prepared suspension stratifies as readily in a dark, constant temperature room as in the open. In Barus' original experiments, described in 1886 (*l.c. ante*) he was particularly careful to guard against convection currents. From the theoretical equation (4) it is seen that the same percentage change in C, T, or M is equally effective against gravity. But a variation (with depth) of say 1 per cent in either C or M is far more likely than in T, where it would amount to 3°C.

Summary

A gradient in kinetic pressure opposes gravity in the settling of fine sediments.

A simple general law is derived for the equilibrium distribution of fine particles in suspension of which Perrin's equation is a special case.

Stokes' Law is given a more general form to include the upward gradient of kinetic pressure as well as gravity as affecting the fall of particles.

The upward diffusion of a given size of particles is limited by the supply, hence the various sizes show a sharp upper limit.

A non-reflecting wall tends to take up a suspension.

Mendenhall and Mason's explanation of stratified settling could not be confirmed experimentally and is shown to be a minor cause in theory.

PALEONTOLOGY.—*New Carboniferous invertebrates*—II.[1] George H. Girty, U. S. Geological Survey.

This paper contains descriptions of seven brachiopods from western Texas.

Schizophoria hueconiana, n. sp.

Figures 29–36

Shell small, transverse, subelliptical in outline.

Pedicle valve strongly transverse, broadly and almost regularly rounded at the sides and more or less straight across the cardinal and anterior margins. The anterior outline, however, is slightly emarginate and the cardinal outline, though essentially straight, is interrupted by the umbonal parts of both valves which project beyond it though not very far. The convexity is rather low and chiefly developed in the posterior half, the anterior half over much of its width being depressed into a broad, fairly deep sinus. Umbonal region rather gibbous. Beak small, pointed, neither strongly incurved nor produced much beyond the hinge. The cardinal line is equal to or nearly equal to one-half the greatest width; scarcely distinguishable in the generally rounded outline. Cardinal area rather low, much wider than high, strongly arched and having a general backward direction of about 145° to the plane of the margin though, because of its curvature, more nearly perpendicular to it in the lower part.

Brachial valve strongly convex, more or less inflated in the umbonal region, and more or less compressed at the sides. Beak small and strongly incurved. The tip of the beak does not project so far beyond the hinge as the parts just in front which are about on a level with the beak of the pedicle valve.

The shell arches strongly from side to side, flaring somewhat near the lateral margins but the curvature is not differentiated into an appreciable

[1] For the previous paper in this series see this Journal 19: 135–142. Published by permission of the Director of the U. S. Geological Survey. Received September 30, 1929.

fold to match the sinus of the other valve. This tends to produce a broad, gentle emargination across the front.

The surface is marked by very fine, sharp, radial lirae, some of which (in the usual manner) gradually rise to a greater prominence than the rest and terminate abruptly in a hollow "spine," represented by a small opening in the shell. These tubular lirae are very small and so little differentiated from the rest that they are apt rather to escape attention than to attract it. Three or four lirae occur in 1 mm. toward the front.

This species might in a sense be regarded as *S. resupinoides* in miniature. It is obviously distinct from that well known Pennsylvanian shell, which nevertheless is the one most comparable to it in our American faunas. It is of course much smaller than *S. resupinoides* and the median sinus in the pedicle valve is much broader. *S. resupinoides,* when of the same size as *S. hueconiana,* has no sinus at all.

The foregoing description is drawn up from the type specimen. My collections contain a number of other specimens but they show little that is additional. Most of them are small and apparently immature and most of them, too, are compressed out of their natural shape. One is as large as 27 mm. in width which is about one-fourth larger than the type. Another is of about the same size as the type and the rest are smaller in varying degrees. About the only part of the foregoing description that needs to be qualified in the light of this other material concerns the sculpture which is better preserved on some of those specimens than on the typical one. The specialized elevated tubular lirae are more conspicuous than they are on the type, but even so the sculpture is developed on so small a scale that the differentiation is only conspicuous under a good lens. These lirae, enlarged and elevated beyond the rest, are in the pedicle valve especially noticeable over the median part, and in the brachial value over the lateral parts, and under a lens they are indeed rather conspicuous. In the immature specimen figured to show this feature, it will be noted that in neither valve is the beak as much incurved as are the beaks of the type specimen. This difference is probably to be attributed to its immature condition as the beaks are commonly more erect in young brachiopods than in old ones, although it may in some degree be an original but individual character and in some degree accidental, due to the compression which the specimen has manifestly suffered.

Horizon and locality: Upper part of the Hueco limestone; Marble canyon, Diablo plateau, Van Horn quadrangle, Texas.

Chonetes quadratus, n. sp.

Figures 4–7

Shell small, highly arched, strongly flexed into median fold and sinus, quadrate in outline, smooth as to surface.

The pedicle valve is transversely subquadrate, scarcely wider at the hinge than in front of it. The sides which are nearly straight and nearly parallel, converge very slightly forward and may be slightly emarginate below the cardinal angles which otherwise vary but little from 90°. The anterior out-

line is broadly and gently concave with abrupt turns where it joins the lateral outlines. The convexity is usually high but it is offset by the unusually broad, deep sinus which is sub-angular at the bottom and, beginning at the beak, deepens and widens rapidly so as to occupy practically the entire anterior margin. The auricles are much depressed and explanate. This combination of characters causes the valve, in other terms, to consist of two high and abruptly rounded ridges that diverge to the two anterio-lateral angles, are separated by the deep broad sinus and descend steeply at the sides to the small explanate auricles. The bases of two small spines are shown on the outer parts of the cardinal area and doubtless several other spines of which there is now no evidence were developed nearer the beak. The surface appears to be quite smooth; it does not even show the small pores or hollow spines which are commonly found in these shells and which must be believed to have been originally present.

Brachial valve unknown.

C. quadratus is more nearly comparable to *C. subliratus* than to any other American *Chonetes* at present known. It is, however, a decidedly smaller shell, is much less extended at the hinge, has a deeper, broader and more angular sinus and is smooth instead of obscurely striated. I have in all five specimens of this species. They vary but little in size and this fact together with their remarkably strong convexity indicates that we are dealing with a species in its mature stage, although the largest is only 11 mm. wide at the hinge. All the specimens are in essential agreement with the decription above formulated. The sides diverge above more in some than in others but *C. quadratus* is not to be compared with *C. subliratus* in this respect any more than it is in size. In the depth and angular shape of the sinus and in the prominent, abruptly rounded ridges between which it lies, *S. quadratus* again is scarcely to be compared with the typical specimen of *C. subliratus*, for in these characters it is as much more, as in the others it is less, pronounced. One of the other figured specimens of *C. subliratus* leans rather more towards *C. quadratus* than the typical one in these last characters, but there is nevertheless a wide difference. If compared with young specimens of *C. subliratus* of equal size, these differences are very marked inasmuch as the convexity is lower and the sinus shallower in young specimens than in old ones. I am not, in this instance, stressing the difference in the surface markings because to some extent the surface markings are the sport of preservation; nevertheless this shell is apparently quite devoid of radial striae whereas *C. subliratus* has fine though somewhat obscure radii. The radial markings may be the product of slight exfoliation but this explanation at present seems scarcely probable.

C. quadratus also recalls the form that Meek described as *C. verneuilianus* var. *utahensis* which seems, however, to be less nearly allied to the present species than to *C. subliratus*. *C. quadratus* consequently differs from it in nearly the same way that it differs from *C. subliratus*—in the less extended hinge, in the deeper, broader, more angular sinus and in the smooth instead of

striated surface. Some doubt may be admitted as to the original markings of *C. subliratus* but v. *utahensis* apparently has the sharply marked lirae of *C. verneuilianus*.

Horizon and locality: Delaware Mountain formation; Victoria peak, Diablo plateau, Van Horn quadrangle, Texas.

Chonetes consanguineus n. sp.

Figures 8–9

Shell of medium size, strongly transverse, semicircular in outline, moderately arched but deflected medially into a fairly strong, narrow fold and sinus, and as to surface essentially smooth or without trace of radial sculpture.

The pedicle valve is semi-circular in outline, much wider than long and widest at the hinge. The outline around the sides and front is an irregular curve, almost straight at the sides above and only gently arched across the front. The sides diverge strongly toward the hinge with which they form acute angles; the cardinal angles may even be slightly extended with the outline below slightly emarginate. The convexity is moderate and is somewhat greater at or in front of the middle than behind it. The umbonal swelling is broad and low passing by degrees into the large, undefined auricles. The sinus is a conspicuous feature being rather deep and rather narrow, though rounded. The cardinal spines are small and numerous; 5 or 6 are indicated on each side of the beak near which there were undoubtedly others that have been destroyed without leaving a trace.

The surface is entirely without radial sculpture and is smooth save for two minor features. Lamellose striae marking stages of growth are fairly numerous but of unequal strength and irregular distribution, while some specimens show the openings left by minute hollow spines or arched scales. These are very numerous and very small; they do not ordinarily interrupt the smooth appearance of the surface but in certain conditions of preservation they give rise to excavations somewhat larger than the pores themselves as if microscopic pieces had been gouged out of the shell.

The brachial valve agrees with the pedicle valve in the usual manner. It is, of course, concave where the other is convex and much less strongly arched. The fold is narrow and rather high but does not make its appearance for some distance in front of the hinge and the beak is scarcely distinguishable except as a point of symmetry.

This species finds its nearest ally apparently in *C. hillanus* and at first might be thought to be identical with it. My collection contains a number of specimens, however, which are uniform in character and which differ from *C. hillanus* in being arched less strongly and in such a manner that in the pedicle valve the highest parts are toward the front instead of toward the back while the umbonal swell is lower and the beak less prominent. The sinus is narrower and perhaps deeper, though narrowness conveys the impression of depth.

C. consanguineus is obviously of the group of *C. geinitzianus* but, I believe, is a distinct species. Geinitz's figures suggest that the original specimen may have been somewhat crushed and that the broad sinus, angular at the bottom, may have had that shape through accident. If those characters are

original, *C. consanguineus* differs markedly from *C. geinitzianus*, and if they are accidental, detailed comparisons can not be made. Besides there does in fact seem to be a species that agrees quite closely with Geinitz's illustrations, so that the illustrations are probably faithful and the original specimens not impaired by accident.

Horizon and locality: Delaware Mountain formation; Victoria Peak, Diablo plateau, Van Horn quadrangle, Texas.

Chonetes victorianus n, sp.

Figures 1–3

Shell rather small, somewhat pentagonal in outline, very convex with a deep narrow fold and sinus, marked by rather coarse and sharply defined radial lirae.

The pedicle valve is distinctly transverse and widest at the hinge which, however, is not much extended. Below the hinge the outlines at the sides are at first nearly straight with a very general convergence forward. They curve increasingly as they pass downward and rather sharply round the antero-lateral angles while the anterior outline again is almost straight or slightly indented at the middle. Owing to the umbonal parts, which project strongly, the outline as a whole approaches the pentagonal. The convexity is extremely high and dome-like. It is interrupted down the middle by a relatively deep, narrow sinus, so that the vault is divided into two rather strongly rounded ridges having a long steep descent on the outward side to the small, oblique, ill-defined auricles. In conformity with these characters the beak is strongly incurved and the umbonal parts project unusually far beyond the hinge line. The cardinal spines are large, numerous and closely arranged, as many as 7 pores, where spines have been broken off can be counted on one specimen on each side of the beak.

The radial lirae are actually fine but for the genus and for the size of the shell they are relatively coarse. They bifurcate several times in sequence so as to form more or less conspicuous fascicles and the sculpture has the appearance of beginning in the umbonal region with a few plications which subdivide and spread out forward. The "hollow spines" or pore-like openings on the lirae are rather large and rather numerous.

C. victorianus, of course, recalls the eastern shell described as *C. verneuilianus* by Norwood and Pratten. That name has been used many times in paleontologic literature and not always, perhaps, for the same species. The species from Missouri that I cited from so many localities as *C. verneuilianus* is not as highly arched or flexed into so deep a fold and sinus as *C. verneuilianus* appears to be either from the figures given by Norwood and Pratten or the later ones given by Meek. Compared with specimens from Missouri, *C. victorianus* is much more inflated, it has a much deeper fold and sinus, and is marked by much sharper and coarser radial lirae. Thus it appears less to resemble these specimens of *C. verneuilianus* than *C. verneuilianus* as figured. I seem not to have available specimens that can be identified with assurance as *C. verneuilianus* but if such a comparison were possible it would, in view of the wide difference in space, time and faunal association, almost certainly show that *C. victorianus* differed also in its specific characters.

Horizon and locality: Delaware Mountain formation; Victoria Peak, Diablo plateau, Van Horn quadrangle, Texas.

Camarophoria inaequalis n. sp.

Figures 10–13

Shell rather small, strongly transverse, widest below the middle, subtriangular in outline, rather gibbous.

Pedicle valve moderately convex with a rather broad and fairly deep sinus. The sinus is almost flat across the bottom with rather steeply ascending sides. Longitudinally the sinus makes a rather strong curve but a line down the lateral parts of the valve would be nearly straight. These gradually rise above the sinus (or the sinus is gradually depressed) so that they are most elevated where they terminate and from the two points overlooking at the sinus they arch obliquely to the lateral margins. The lateral parts of the shell are much shorter than the part comprising the sinus which projects beyond them in a linguiform manner. At their termination the sinus occupies rather more than one-third of the entire width. The beak, though missing in my specimens, is presumably pointed, sub-erect and rather prominent.

The costae in the sinus are slender and sharply rounded; those on the lateral slopes are larger and more lax. In the type specimen the sinus contains 7 plications and the lateral slopes 4 each with a fifth suggested, the fourth also being short and rather indistinct. The slender plications in the sinus can be distinguished at points farther back than the larger ones of the lateral slopes but all of them fail to reach the umbonal portion.

The brachial valve is gibbous, strongly arched from back to front and likewise strongly arched from side to side. The longitudinal curvature is more pronounced down the lateral parts than down the middle so that the lateral slopes fall away from the fold leaving it a feature though well defined, not very strongly elevated. It is distinctly less elevated than the sinus is depressed; it occupies somewhat less than one-third the width, (only the upper surface being considered) and it is shorter than the lateral slopes which extend appreciably beyond it.

The plications, like those of the pedicle valve, are narrow and sharp on the fold but much larger and somewhat weaker on the lateral slopes. Eight plications occur on the fold, the first apparently branching off from the second and the 8th from the 7th. On the lateral slopes the plications number three with two others of scarcely appreciable strength. As in most shells of this genus, the plications here are irregular in their development, some branching from others as just mentioned and some, on the other hand, attaining normal strength only to disappear farther on.

The foregoing description is based on the type specimen. A second specimen from the same locality agrees with the typical one in its essentials very closely. The fold has only seven plications instead of eight but the first and seventh are branches of the second and sixth in a manner precisely similar. The lateral slopes have three plications of much larger size than those on the median part with one or two others scarcely distinguishable toward the sides. A third specimen shows more noteworthy differences; the fold has seven plications of which the first branches from the second but not the seventh from the sixth. In this specimen the lateral slopes bear almost as numerous, almost as slender and almost as strong plications as the fold.

There are probably seven of these on each side, although the sixth is short and small and the seventh is only obscurely suggested.

Horizon and locality: Delaware Mountain formation, North Apache canyon, Diablo plateau, Texas.

Camarophoria hueconiana n. sp.

Figures 14–21

Shell small, sub-triangular, with the length decidedly less than the greatest width which occurs well forward.

Pedicle valve rather convex and over the median part very strongly arched from back to front. Beak strongly incurved. Umbonal region somewhat inflated. Beginning about one-third the shell length from the beak the median part of the valve becomes depressed into a broad sinus which toward the front occupies about one-half of the entire width if the bounding slopes are included in the sinus. The lateral areas on either side of the sinus are relatively narrow and strongly rounded. The sinus bears 4 rather slender but fairly strong costae which make their appearance well back toward the umbo, before the sinus is an appreciable feature. The lateral slopes are marked by 4 costae of about the same character as those in the sinus though they cannot be traced as far backward and the final costae on each side are very short.

The brachial valve is rather strongly convex, strongly arched from back to front and more strongly arched from side to side. The fold, including its sloping sides, occupies about one-half of the entire valve toward the front but is not strongly elevated except close to the anterior margin. In the front view the fold and sinus are rather high, sharply defined and save for their sloping sides rather flat. The fold bears 5 costae and the lateral slopes 4 each, the costae on the lateral slopes being somewhat conspicuously different from those on the fold for the latter are fairly stout and equal in size to the grooves between them whereas the costae on the lateral slopes are slender and distinctly narrower than the grooves. They appear narrow and also weak, the final one on each side being quite faint.

The foregoing description is drawn up from the typical specimen. Other specimens show certain variations from the characters just noted. The fold may have only 4 plications instead of 5, though this seems to be rare, or it may have 6 which is more common than 4, but decidedly less common than 5. Where 6 occur, the supernumerary costa as a rule is an offshoot from the normal ones; in fact in one specimen on which 5 costae are found only 3 so to speak, are original, the two lateral ones being offshoots from the primary costae to which they are adjacent. Again the contrast between the costae of the lateral slopes and those of the fold is rarely as conspicuous as it is in the type specimen.

The only American species of *Camarophoria* that can be regarded as belonging to the same group with *C. hueconiana* is *C. venusta* but the differences between the two are so obvious as scarcely to need discussion.

Horizon and locality: Upper part of the Hueco limestone; spur south of Cerro Alto, Cerro Alto quadrangle, Texas.

Pugnoides mesicostalis n. sp.

Figures 22–28

Shell rather large, strongly transverse, subelliptical to subpentagonal in outline.

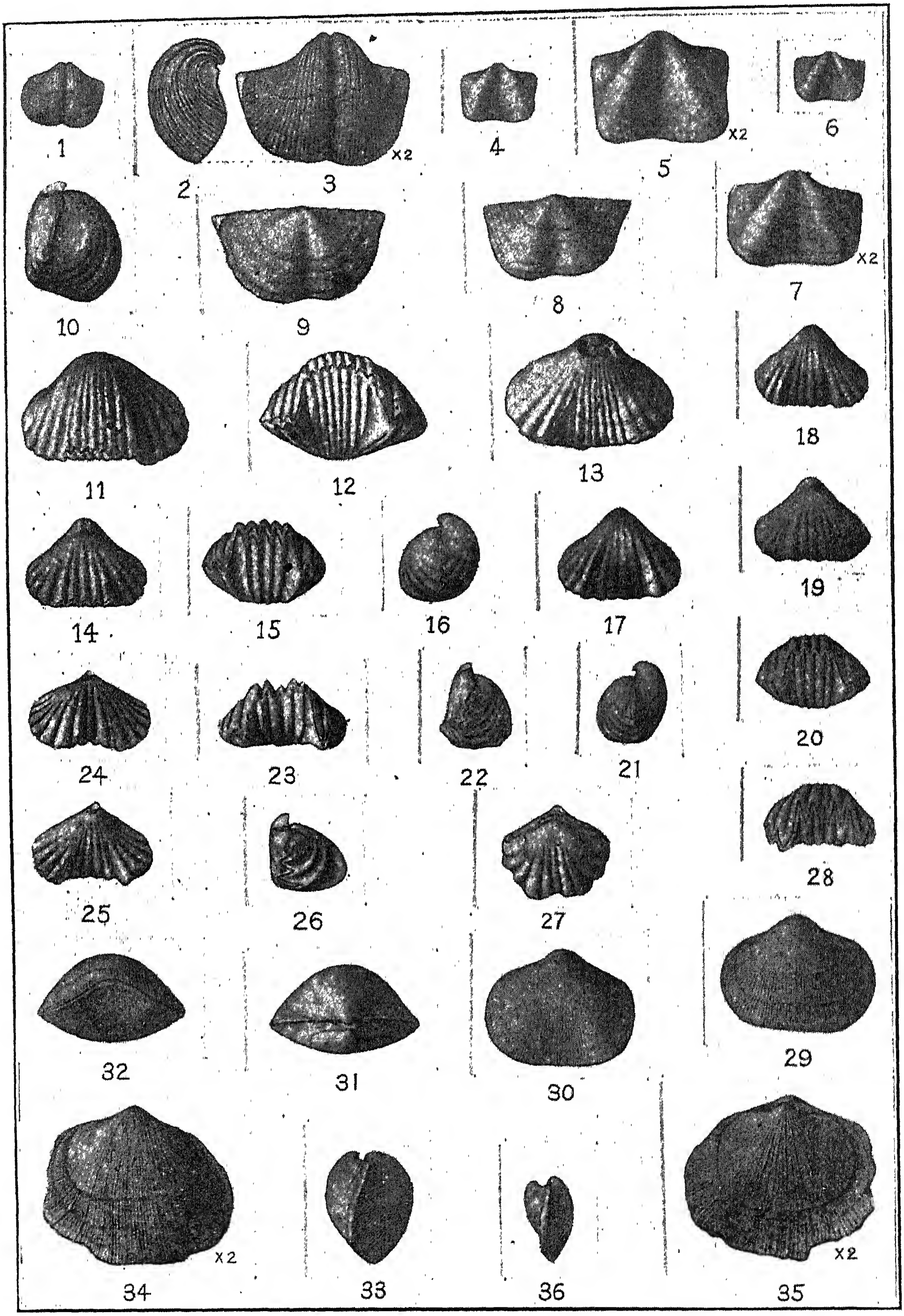
Pedicle valve rather shallow by reason of the large, deeply depressed sinus. The part constituting the sinus extends forward considerably beyond the lateral parts but where they terminate it occupies about half the total width of the valve, if its sloping sides are included in this measurement. The lateral parts are almost flat and almost complanate, and as the sinus is oblique to this level, besides being increasingly arched, they become much elevated above it and terminate in sharp points on either side. The plications are strong and subangular, 4 on the sinus and 5 on each of the lateral slopes, the fifth, however, being short and weak.

The brachial valve is rather strongly convex in a transverse direction but much less convex longitudinally. Along the fold the curvature is very gentle; along the lateral slopes it is stronger and as the sides are oblique, as well as more highly arched, the fold is elevated well above the more remote parts of the lateral slopes. The plications are strong and angular. As is common in this group of shells, those on the fold are more acutely angular than those in the sinus, but on the other hand, the plications of the lateral slopes on the pedicle valve are more acutely angular than those on the lateral slopes of the brachial valve. Five plications occur on the fold, of which the median one is conspicuously smaller than the two on each side of it and also conspicuously depressed below them. The lateral slopes bear five plications, the last one on each side being short and rather indistinct. On the other hand, the median plication can be traced farther back on the umbo, and the two on each side, when traced backward, appear to merge as if they resulted from the bifurcation of a single large one.

The foregoing description is drawn up from the type specimen. A second specimen shows the same general characters with certain modifications in detail. It is somewhat more transverse and somewhat more gibbous. The plications on the fold are like those of the typical specimen both in number and in character (five, with the middle one small and depressed); the lateral plications, however, are larger and fewer. I recognize but three on each lateral slope with a fourth indicated more by a denticle on the margin than a plication on the surface.

Pugnoides mesicostalis recalls *P. elegans* in the aborted development of the median rib of the fold but this species has five plications on the fold and that but three, besides which are other differences too obvious to need designation.

Horizon and locality: Delaware Mountain formation; North Apache canyon, Diablo plateau, Texas.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x2

DESCRIPTION OF FIGURES

Chonetes victorianus, n. sp. (p. 410).

Figs. 1–3 . The type specimen, a pedicle valve, natural size and enlarged × 2. Delaware Mountain formation, Victoria Peak, Van Horn quadrangle, Texas.

Chonetes quadratus, n. sp. (p. 407).

Figs. 4–7 . Two cotypes, both pedicle valves, natural size and enlarged, × 2. Delaware Mountain formation, Victoria Peak, Van Horn quadrangle, Texas.

Chonetes consanguineus, n. sp. (p. 409).

Figs. 8–9 . Two cotypes, both pedicle valves. Delaware Mountain formation, Victoria Peak, Van Horn quadrangle, Texas.

Camarophoria inaequalis, n. sp. (p. 411).

Figs. 10–13. Four views of the typical specimen. Delaware Mountain formation, North Apache Canyon, Diablo Plateau, Texas.

Camarophoria hucconiana, n. sp. (p. 412).

Figs. 14–21. Different views of two specimens, the cotypes. Hueco limestone (upper part), spur south of Cerro Alto, Cerro Alto quadrangle, Texas.

Pugnoides mesicostalis, n. sp. (p. 413).

Figs. 22–25. Four views of the type specimen.

Figs. 26–28. Three views of a somewhat different specimen. Delaware Mountain formation, North Apache Canyon, Diablo Plateau, Texas.

Schizophoria hueconiana, n. sp. (p. 406).

Figs. 29–33. Five views of the type specimen.

Figs. 34–36. Three views of another specimen (figs. 34 and 35), enlarged × 2. Hueco limestone, Marble Canyon, Van Horn quadrangle, Texas.

BOTANY.—*A new variety of henequen without prickles.*[1] LYSTER H. DEWEY, U. S. Department of Agriculture.

Henequen, *Agave fourcroydes* Lemaire, was introduced into Cuba from Yucatan about 1840. Plants descending from that early introduction, propagated chiefly by bulbils and suckers—rarely from seeds—have been used since 1900 in developing large plantations equipped with modern fiber-cleaning machines. These plants, like those of Yucatan, have prickles 1 to 4 mm. long and 10 to 20 mm. apart on the margins of the leaves. The prickles are hooked either upwardly or downwardly and often in both directions on the same leaf.

In 1926, Mr. George H. Simons, President of Compañia Hispano-Americana de Henequen, S. A., found among the plants cultivated by that company at Nuevitas, Cuba, a plant without prickels on the margins of the leaves. The numerous suckers of this plant also had leaves free or nearly free from marginal prickles. This form, originating as a mutation in one plant and continued in its progeny is regarded as worthy of varietal distinction.

[1] Received September 17, 1929.

Agave fourcroydes espiculata Dewey, var. nov.

Mature plant at flowering time with trunk up to 1 m. below the leaves; leaves gray-green, slightly darker on face, 120 to 150 cm. long, 12 to 14 cm. wide, nearly cylindrical and about 3.5 cm. in diameter at base, terminal spine dark chestnut, shiny on upper half, duller and finely pitted under a lens on lower half, 20 to 30 mm. long and 6 mm. in diameter, slightly decurrent on back and margins, with shallow or indistinct groove on lower half of face; margins of leaf straight and smooth, without even rudimentary prickles, or rarely 2 to 6 small prickles on some of the leaves; flower stalk about 5 m. high, bearing dense clusters of erect flowers on very short pedicels on the forked ends of nearly horizontal branches; flowers with green ovary about 20 mm. long, constricted at top, and light yellow perianth about 30 mm. long, the lobes slightly longer than the tube; stamens with curved anthers exserted about the length of the lobes beyond the perianth and style with 3-lobed stigma extending beyond the stamens.

Type in the U. S. National Herbarium, no. 1,411,770, collected at Nuevitas, Cuba, January 14, 1929, by George H. Simons.

This variety differs from the typical form of the species in the absence of prickles on the margins of the leaves and in the narrower and more nearly cylindrical base of the leaves. The flowers are like those of the species except slightly smaller.

The mother plant is exceptionally vigorous, having produced about 350 leaves as compared with about 250 for average henequen plants, and 120 suckers which are also exceptionally vigorous. The mother plant was about 15 or 16 years old at the time of flowering in May, 1929. The variety is of economic interest because the smooth-margined leaves may be handled more easily than those with prickles.

SCIENTIFIC NOTES AND NEWS

At the recent meeting of the American Chemical Society at Minneapolis it was stated that the membership of the Society is now well over 17,000. Papers were presented before seventeen different divisions, and a number of other group meetings were held.

Miss J. L. V. McCord, long connected with the Geological Survey and Librarian for the past 21 years, has retired. Mr. Guy E. Mitchell succeeds Miss McCord as Librarian.

A. Nelson Sayre has been appointed assistant geologist in the Water Resources Branch of the Geological Survey.

C. H. Birdseye has resigned as Chief Topographic Engineer of the Geological Survey and J. G. Staack has been appointed to this position.

Glenn S. Smith has resiged as division engineer of the Atlantic Division of the Topographic Branch and Albert Pike has been appointed to this position. Mr. Smith will continue part time service in the Survey.

Doctor HERBERT FRIEDMANN has been appointed Curator of Birds in the National Museum. Doctor Friedmann held a National Research Council fellowship from 1923 to 1926, during which time he investigated the habits of parasitic birds. He is especially interested in the birds of Africa.

Professor A. S. HITCHCOCK, Agrostologist of the Department of Agriculture, who has been studying the grasslands of Kenya Colony, left Mombasa toward the end of September, and expects to reach Washington about the middle of November.

MONTROSE W. HAYES, recently in charge of the St. Louis station of the Weather Bureau, has been selected as chief of the river and flood division of the Bureau and reported for duty in Washington early in October.

On September 23rd, Mr. NEIL M. JUDD, Curator of American Archeology in the National Museum, returned to Washington after four months' field work in Arizona under the auspices of the National Geographic Society. Mr. Judd's investigations this summer were chiefly concerned with the collection of beams from prehistoric pueblo ruins. There is but a single remaining gap in the "tree ring" chronology being erected by Doctor A. E. DOUGLASS, of the University of Arizona, and it is hoped with this summer's beam collection to bridge this gap and thus make possible the dating of Pueblo Bonito and other pre-Spanish ruins of the Southwest. Although under the general direction of Mr. Judd, the National Geographic Society's 1929 excavations were directly supervised by Mr. L. L. HARGRAVE, of the Museum of Northern Arizona, Flagstaff, and Mr. E. W. HAURY, of the University of Arizona, Tucson. A review of the material resulting from the expeditions is now being made by Doctor Douglass and a report is anticipated in the near future.

Obituary

Dr. GEORGE PERKINS MERRILL, Head Curator of the Department of Geology, U. S. National Museum, and a member of the ACADEMY, died suddenly from heart disease on August 16th, 1929, in a railroad station at Auburn, Maine. He was born in Auburn May 31, 1854, and attended the University of Maine, where he received the degrees of B.S. in 1879, M.S. in 1883, and Ph.D. in 1889. He also took work at Wesleyan and Johns Hopkins Universities, and in 1917 was awarded the honorary degree of Sc.D. by George Washington University. After teaching for brief periods at various institutions, he was appointed an assistant in the Department of Geology of the Museum in 1881, gradually advancing until he became Head Curator of the Department in 1897. In 1890–91 he was a lecturer in geology at the University of Maryland, and from 1893 to 1915 Professor of Geology and Mineralogy at George Washington University. He belonged to a number of scientific societies; was a fellow of the Geological Society of America (Vice President, 1920), a member of the Geological Society of Washington (President, 1906), and was elected a member of the National Academy of Sciences in 1922. He also received from this organization the J. Lawrence Smith gold medal in recognition of his work on meteorites.

Doctor Merrill's scientific work covered many branches of geology and related sciences, his special fields of interest being the non-metallic minerals, meteorites, and the history of geology, especially in America. In the first of

these fields, he wrote several books, including: Stones for Building and Decoration; Rocks, Rock Weathering and Soils; and The Non-metallic Minerals, Their Occurrence and Uses. He made detailed studies of the chemistry and mineralogy of meteorites, published in numerous briefer papers, and one comprehensive work, Handbook and Descriptive Catalogue of the Meteorite Collections in the U. S. National Museum (1916). One mineral of frequent occurrence in stony meteorites, which had been misinterpreted in various ways by other workers, was shown by his microchemical tests to be a phosphate unknown in terrestrial rocks, and it was appropriately named in his honor, merrillite. In the course of his historical studies, he assembled a remarkably comprehensive collection of autographs and portraits of workers in geology and related sciences. From these studies there resulted his History of American Geology, History of American State Geological and Natural History Surveys. and The First One Hundred Years of American Geology. Shortly before his death he completed The Story of Meteorites, Part 1 of Minerals from Earth and Sky, Volume 3 of the Smithsonian Scientific Series.

Dr. Charles Williamson Richardson, Emeritus Professor of Laryngo-ology and Otology in George Washington University and a member of the Academy, died August 25, 1929. He was born in Washington, D. C., August 22, 1861, studied at the University of Pennsylvania and at George Washington University, taking the degree of Doctor of Medicine in 1884. He was given the honorary degree of Doctor of Science by George Washington in 1921. Dr. Richardson wrote numerous papers dealing with problems in otorhinology and laryngology, in which fields he was an eminent specialist.

Dr. Frank Hurlburt Chittenden, Senior Entomologist, Bureau of Entomology, Department of Agriculture, died September 15, 1929. He was born in Cleveland, Ohio, November 3, 1858, graduated from Cornell University in 1881, and received the honorary degree of doctor of science from the University of Pittsburgh in 1904. He was an authority on truck-crop insects, and on the taxonomy of certain groups of Coleoptera, and had contributed extensively to entomological literature.

Dr. Edwin Emery Slosson, Director of Science Service and a member of the Academy, died October 15, 1929. He was born in Sabetha, Kansas, June 7, 1865, and attended the University of that state, receiving the degrees of B.S. in 1890 and M.S. in 1892. He also took advanced work at the University of Chicago, leading to the receipt of a Ph.D. in 1903; and in 1923 the same University awarded him the degree of LL.D. He was Professor of Chemistry at the University of Wyoming and Chemist at the State Experiment Station from 1891 to 1904, resigning to take up literary work. In 1921 he was appointed to the position which he held up to the time of his death. Combining, to an unusual degree, literary skill with a broad knowledge of science, his numerous essays and books have been highly successful in bringing to the layman an appreciation of scientific ideas and of the significance of modern advances in science.

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BIOCHEMISTRY.—*The determination of glutathione with especial reference to human blood.*[1] Walter C. Hess, Department of Biochemistry, George Washington University Medical School. (Communicated by M. X. Sullivan.)

In 1903 Buffa[2] showed that certain animal tissues give a positive color reaction with sodium nitroprusside and ammonia. This observation was confirmed by Heffter[3] and later by Arnold.[4] The latter suggested that, since the test was given by protein-free tissue extracts, the nitroprusside reaction is due to free cysteine. In 1921 Hopkins[5] succeeded in isolating from yeast, mammalian muscle, and mammalian liver, a substance giving the nitroprusside test. This substance proved to be a dipeptide of cysteine and glutamic acid and Hopkins assigned to it the name glutathione. Due to the presence of the reversible system $H_2 + S-S \leftrightharpoons SH + SH$, this compound assumed great importance in the field of biological oxidation-reduction.

Tunnicliffe[6] devised a method for the estimation of glutathione dependent upon the fact that the SH group could be oxidized by iodine to the $S-S$ group and reported upon the glutathione content of a number of tissues. In rabbit, rat and human blood, however, he was unable to find any glutathione. This finding was in partial agreement, at least, with the earlier report of Hopkins (*loc. cit.*) that glutathione was not present in blood plasma. This result was reported despite the earlier finding of Arnold (*loc. cit.*) that protein-free blood-corpuscle

[1] Received October 8, 1929.

[2] E. Buffa. . Journ. Physiol. Path. Gén. **6**: 645. 1903.

[3] A. Heffter. Mediz. naturw. Arch. **1**: 81. 1905.

[4] V. Arnold. Z. physiol. Chem. **70**: 314. 1910.

[5] F. G. Hopkins. Biochem. Journ. **15**: 286. 1921.

[6] H. E. Tunnicliffe. Biochem. Journ. **19**: 194. 1925.

filtrates gave a positive test with sodium nitroprusside and ammonia. This test Arnold attributed to the presence of free cysteine.

A short time after the appearance of Tunnicliffe's work, Holden[7] reported the isolation of 50 mg. of glutathione from a liter of sheep blood. He found the glutathione to be wholly confined to the corpuscles. Harding and Cary[8] the following year used the Folin-Looney cystine method on protein-free filtrates from ox blood. They estimated the glutathione content of ox blood to be approximately 10 mg. per 100 cc. of whole blood. Hunter and Eagles,[9] following the work of Holden, isolated from pig blood-corpuscles a compound yielding cystine and glutamic acid on hydrolysis, but which differed somewhat in analysis from the glutathione of Hopkins. They estimated, using the nitroprusside test, that pig, sheep and cat blood corpuscles contain 100 to 120 mg. of glutathione per 100 cc. of corpuscles.

TABLE 1.—Glutathione, mg. per 100 cc. of Whole Blood.

	Thompson and Voegtlin	Blanchetiere, Binet and Melon		Brown and Kolmer	Hunter and Eagles	Harding and Cary	Uyei
		Arterial Blood	Venous Blood				
Dog	20	15.4	18.9	29			10
Rat	22			28			25
Hog	31				47		
Beef	35					10	
Calf	36						
Sheep	38						
Rabbit	49			38			30
Guinea pig	49			34			45

Various other workers employing the Tunnicliffe method have investigated the glutathione content of mammalian blood. Table 1 shows the results obtained by Thompson and Voegtlin;[10] Blanchetiere, Binet and Melon;[11] Brown and Kolmer;[12] and Uyei.[13] The results obtained by Hunter and Eagles with the nitroprusside method are shown, as are also the results of Harding and Cary using the Folin-Looney cystine method.

[7] H. F. Holden. Biochem. Journ. **19**: 727. 1925.

[8] T. S. Harding and C. A. Cary. Proc. Soc. Exp. Biol. Med. **23**: 319. 1926.

[9] G. Hunter and B. A. Eagles. Journ. Biol. Chem. **72**: 133. 1927.

[10] J. W. Thompson and C. Voegtlin. Journ. Biol. Chem. **70**: 793. 1926.

[11] A. Blanchetiere, L. Binet and L. Melon. Compt. Rend. Soc. Biol. **97**: 1049. 1927.

[12] H. Brown and J. A. Kolmer. Journ. Pharmacol. Exp. Therap. **35**: 417. 1929.

[13] N. Uyei. Journ. Infect. Dis. **39**: 73. 1926.

More recently Turner,[14] using the Tunnicliffe method, found an average of 107 mg. per 100 cc. of human corpuscles. Benedict and Newton[15] gave as an average of 18 determinations 55 mg. per 100 cc. of whole blood. Their method is based on the nitroprusside test, similar to that used by Hunter and Eagles, but they state that they regard the figures obtained as of very questionable accuracy. They also doubt whether even a reasonably accurate procedure can be worked out on their modified Hunter-Eagles method.

Considering the variation in these figures it would appear worth while to attempt to determine glutathione by an entirely different method. In work on the estimation of cystine and cysteine at the Hygienic Laboratory two methods have been used: the specific 1,2-naphthoquinone-4-sodium sulfonate test for cysteine and cystine, after reduction by sodium cyanide, developed by Sullivan,[16] and the iodometric method of Okuda.[17] The Okuda method is based upon the fact that cysteine and reduced cysteine (treated with zinc and hydrochloric acid), are oxidized to cystine by potassium iodide and potassium iodate in acid solution. The reaction used is not specific for cystine and cysteine, but will be given by any SH compound and any S–S compound that is reducible by zinc and hydrochloric acid to the SH form.

Glutathione is a compound existing in both the SH and S–S forms, and, therefore, it should be possible to determine it quantitatively by means of the Okuda method. Using the latter, together with the specific reaction for cystine and cysteine devised by Sullivan, it in fact becomes possible not only to distinguish between these various compounds but also to determine them quantitatively.

Various methods for obtaining a protein-free blood filtrate were tested, bearing in mind the finding of Harding and Cary[18] that cystine added to blood was not recovered quantitatively after deproteinizing with trichloracetic acid. Cystine added to blood and then deproteinized by the Folin-Wu[19] method gave varying recoveries dependent upon the amount of cystine added. The procedure was to add the weighed amount of cystine directly to the measured volume of blood (5 cc.) and then precipitate as required by the Folin-Wu procedure.

[14] R. H. TURNER. Proc. Soc. Exp. Biol. Med. **25**: 541. 1929.
[15] S. R. BENEDICT and E. B. NEWTON. Journ. Biol. Chem. **83**: 361. 1929.
[16] M. X. SULLIVAN. U. S. Public Health Reports **41**: 1030. 1926.
[17] Y. OKUDA. Journ. Biochem. (Tokyo) **5**: 201. 1925.
[18] T. S. HARDING and C. A. CARY. Journ. Biol. Chem. **78**: xlix. 1928.
[19] O. FOLIN and H. WU. Journ. Biol. Chem. **38**: 81. 1928.

A known amount of the protein-free blood filtrate, the reaction of which was approximately pH 7, was brought to pH 3.5 with normal hydrochloric acid. The cystine content was determined colorimetrically as follows: To 5 cc. of the solution add (a) 2 cc. of 5 per cent aqueous sodium cyanide, wait ten minutes, add (b) 1 cc. of a freshly prepared 0.5 per cent aqueous solution of 1,2-naphthoquinone-4-sodium sulfonate, mix, and add (c) 5 cc. of a 10 per cent solution of anhydrous sodium sulfite in 0.5 N sodium hydroxide, mix, and wait 30 minutes. Then add (d) 1 cc. of a 2 per cent solution of sodium hyposulfite ($Na_2S_2O_4$) in 0.5 N sodium hydroxide. A solution of cystine of known concentration treated in the same manner was used as the standard for comparison in a Klett biocolorimeter. Using the recently published method of Benedict and Newton[20] for obtaining protein-free blood filtrates, the same experiment was repeated with better recoveries of added cystine. The results, using both methods of protein precipitation, are shown in Table 2.

TABLE 2.—RECOVERIES OF CYSTINE ADDED TO BLOOD

Blood, cc.	Cystine added, mg.	Cystine recovered, mg.	
		Folin-Wu	Newton-Benedict
20	6	2.1	5.7
20	4	1.1	3.8
20	2	0	1.9

With recoveries of added cystine well within the limit of error of the method, the possibility remained that some of the cystine found came from the blood itself. An experiment was therefore performed to determine whether or not human blood contained any free cystine or cysteine. Several methods for deproteinizing were used—first the Folin-Wu, second, the Benedict-Newton, and, third, a new method involving the use of anhydrous sodium sulfate. The protein-free filtrates obtained by both the Folin-Wu and Benedict-Newton methods were adjusted to pH 3.5 and tested for cystine and cysteine by the Sullivan method, with negative results.

The two filtrates each represented a ten to one dilution of the blood and so might be too dilute and thus below the order of reactivity of the method. However, on concentrating both filtrates, under reduced pressure, back to the original blood volume, adjusting the reaction to pH 3.5, and again applying the Sullivan method for cystine and cysteine, neither was found.

[20] S. R. BENEDICT and E. B. NEWTON. Journ. Biol. Chem. **83**: 357. 1929.

The sodium sulfate method, which Sullivan and Hess, in work to be published, have found to give good results with tissues with only a two to one dilution, was next employed. The procedure is as follows: To 5 cc. of blood in a 150 cc. mortar add 3 grams anhydrous sodium sulfate and 5 cc. 10 per cent sulfuric acid dropwise, and with continual grinding. Filter, using a Buchner funnel and hard paper, scrape the material from the filter paper, and put it back into the mortar with 0.5 gram of anhydrous sodium sulfate, adding another 2.5 cc. of 10 per cent sulfuric acid and grinding. Then filter as before, bringing the combined filtrates to pH 3.5 with a few drops of 5 N sodium hydroxide, added dropwise and with constant stirring. The Sullivan method applied to 5 cc. of this filtrate also showed the absence of both cysteine and cystine. These experiments were all performed on relatively fresh blood, three of the samples being precipitated within a few minutes after drawing the blood and two within one hour after drawing the blood. The specificity of the Sullivan reaction has been discussed in papers by Sullivan[21] and Sullivan and Hess,[22] and it can be concluded with a high degree of probability that within the limits of the methods at hand, human blood is lacking in both cystine and cysteine.

The Okuda method, as applied to the determination of glutathione, requires the following solutions:

(1) $\frac{M}{1200}$ potassium iodate made by dissolving 0.5350 g. potassium iodate in 3 liters of 2 per cent hydrochloric acid.
(2) 4 per cent hydrochloric acid.
(3) 5 per cent aqueous potassium iodide.

Ten cubic centimeters of the protein-free filtrate, obtained by the Benedict-Newton method, are made to exactly 2 per cent with concentrated hydrochloric acid, 2.5 cc. of the 5 per cent potassium iodide are added and 2.5 cc. of the 4 per cent hydrochloric acid solution. The solution is then cooled to 20°C. and titrated with $\frac{M}{1200}$ potassium iodate until a yellow color appears and persists for one minute. During the titration the temperature is not allowed to rise over 20°C. This is important, as large errors are introduced by not maintaining a constant temperature. The $\frac{M}{1200}$ potassium iodate is standardized

[21] M. X. SULLIVAN. U. S. Public Health Reports **44**: 1030. 1929.
[22] M. X. SULLIVAN and W. C. HESS. U. S. Public Health Reports **44**: 1599. 1929.

against reduced glutathione dissolved in 2 per cent hydrochloric acid, 10 cc. of that solution being titrated exactly the same as 10 cc. of the protein-free blood filtrate.

This method determines only the reduced glutathione. To determine the oxidized glutathione it is necessary to reduce the S–S grouping to the SH form. The procedure for this is as follows: To 10 cc. of the filtrate add 1.0 cc. of concentrated hydrochloric acid and a few decigrams of zinc powder and boil gently for 10 minutes. Filter and wash thoroughly. Adjust the acidity of the filtrate to exactly 2 per cent with concentrated hydrochloric acid, add 2.5 cc. of 5 per cent potassium iodide and 2.5 cc. of 4 per cent hydrochloric acid and cool to 20°C. The titration is the same as for reduced glutathione. Table 3 shows the results for 5 samples of normal blood.

TABLE 3.—GLUTATHIONE
Milligrams per 100 cc. whole blood

Blood	Before reduction	After reduction
1	58	61
2	55	58
3	64	66
4	60	63
5	59	63

TABLE 4.—CYSTINE
Milligrams per 100 cc. whole blood

Blood	Sullivan	Okuda	Theoretical
1	26.9	27.3	29.3
2	24.3	25.0	27.8
3	28.5	29.1	31.7
4	27.7	28.3	30.2
5	27.4	28.5	30.2

Glutathione is considered as being a dipeptide of cystine and glutamic acid and should, on hydrolysis, yield these two amino acids. The amount of glutathione originally present can then be determined by using the Sullivan method to estimate the cystine in the hydrolysate. By hydrolyzing a blood filtrate and determining the cystine in the hydrolysate it should be possible to check the findings by the Okuda method. Accordingly another portion of the same filtrate was concentrated under reduced pressure to the original blood volume, made to 20 per cent acidity with concentrated hydrochloric acid, and hydrolyzed at 125°C. for six hours. The hydrolysis was carried out in an acetylation flask immersed in an oil bath. The hydrolysate was colorless, and was poured into a beaker, the flask washed and the washings added to the beaker. The solution was brought to pH 3.5 with 5N NaOH, added dropwise with stirring. Cystine was determined in this solution by the Sullivan method and also by the Okuda method. The results agree within less than 10 per cent of the amount required for the glutathione present. The results are shown in Table 4.

The only substance known to exist in blood that might possibly be thought to interfere in the Okuda method is ergothioneine. However, the sample of ergothioneine in the laboratory did not react in Okuda's method until it had been reduced with zinc and hydrochloric acid. It could not, therefore, interfere in the determination of reduced glutathione, which has been found to be 95 per cent of the total glutathione, if the analysis is performed within one hour after drawing the blood. The factor on the $\frac{M}{1200}$ potassium iodate for 10 mg. reduced glutathione is 6.48 cc., while for 10 mg. ergothioneine after reduction it is only 0.03 cc. The amount of ergothioneine in 100 cc. of human blood averages about 7.5 mg., according to Behre and Benedict.[23] The titer, then, for the amount present in one or two cc. of blood is negligible. However, a method for eliminaing ergothioneine has been devised and will be described in a later paper.

Summary.—A method for the determination of glutathione in blood has been described. The average amount found in normal human blood is 59 mg. before reduction and 62 mg. after reduction. No cystine nor cysteine was found in normal human blood. The method has been found to be more accurate than the Tunnicliffe outside indicator method, and is being applied to a number of pathological bloods.

PALEONTOLOGY.—*A new Eocene* Leda *from Black Bluff, Alabama.*[1] JULIA A. GARDNER, U. S. Geological Survey.

Through the interest and generosity of Dr. Walter B. Jones, the State Geologist of Alabama, I had the good fortune in late July of 1929, to join a small party from the University of Alabama on a two-day collecting trip to Black Bluff, Sumter County, on the Tombigbee River about 15 miles in an air line below Demopolis and 2½ miles below the mouth of Sucarnoochee Creek. Black Bluff is a superb exposure extending for fully half a mile along the western bank of the Tombigbee. Under the caption, "The Black Bluff or Sucarnochee Series," the section was described by Dr. E. A. Smith[2] over thirty years ago, the fossils having been listed even earlier by Truman H. Aldrich.[3] Ever

[23] J. A. BEHRE and S. R. BENEDICT. Journ. Biol. Chem. **82**: 11. 1929.

[1] Published by permission of the Director, U. S. Geological Survey. Received October 5, 1929.

[2] EUGENE A. SMITH, LAWRENCE C. JOHNSON, and DANIEL W. LANGDON, JR. Ala. Geol. Survey Rept., Geology Coastal Plain Ala. 186. 1894.

[3] TRUMAN H. ALDRICH. Ala. Geol. Survey Bull. **1**: 60. 1886.

since that time, it has served as a valuable check both lithologically and faunally for the Sucarnoochee clay, the middle formation of the Midway, the lowest group in the Eocene.

Unlike so many of the older localities, Black Bluff is today easily recognizable from the early descriptions, though it may have suffered a certain amount of slumping from the first altitude estimate of eighty feet. The heavy shingle of limonite concretions near the water's edge, a feature mentioned by Doctor Smith, is still a striking character. The bed is uncommonly persistent, for flood waters would certainly have washed away a softer series during thirty-five years. A ferruginous conglomerate made up largely of fucoidal concretions is characteristic of the upper end of the Bluff. Organic remains, particularly *Trochocyathus hyatti* Vaughan, are superficially embedded in large numbers upon the upper surface. Other flattened concretions of irregular outline, resembling masses of small shot and possibly containing some barite, are fairly common. Rosettes of selenite crystals are abundant in the upper part of the section at the lower end of the bluff. Although in the greater part of the section they are not sufficiently calcareous to react to acid, the clays contain, locally, numerous lime nodules. The clay is a true gumbo, slaty black, very fine and homogeneous, breaking with a conchoidal fracture, massive and impossible to walk upon when wet, splitting and spreading on drying like thick leaves of a heavy book.

The Black Bluff fauna is small and, to a certain extent, segregated. Crustacean remains are most common at the upper end of the Bluff, about fifteen to twenty feet above the base of the ledge which outcrops at the river margin at moderately low water. Small univalves, particularly turritids, are fairly plentiful just above the crustacean bed. Some of the turritids are new but too imperfect to warrant description. *Volutocorbis rugatus* (Conrad), *Olivella*, possibly *mediavia* Harris, an indeterminate naticoid, and a new but imperfect species of *Architectonica* were collected from the same section but eight to ten feet below the crabs. It is highly probable that this gastropod zoning is due in large part to the accidents of collecting, although the crustaceans seem to be confined in large measure to a single definite horizon. Bivalves are relatively rare at the upper end of the Bluff but very large and well preserved *Nucula mediavia* Harris, *Leda* (*Ledina*) *jonesi* new species and *Cucullaea macrodonta*, together with *Enclimatoceras* fragments, are fairly common a quarter to half a mile downstream. *Trochocyathus hyatti* Vaughan, a small solitary coral, is perhaps the only

form fairly common throughout the vertical section and the entire length of the outcrop. One of the most remarkable features of the Black Bluff fauna is the apparent absence of *Venericardia* and *Turritella*, by far the most conspicuous groups both in the Clayton limestone beneath and in the Naheola above. Not a fragment of either genus was observed nor has any species been reported by Aldrich or by Harris. Habitat and not the time element was apparently the determining factor in excluding these two genera so prominent in the Midway life. Shallow but undisturbed waters probably covered the silty bottom. Deep-water conditions would have made life impossible both for the corals and the crabs, and an inrush of sediment would have buried the corals, the most prevalent forms in the fauna.

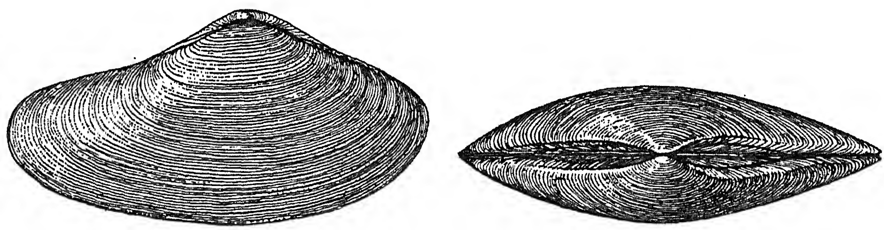

Figure 1. *Leda (Ledina) jonesi* n. sp.[4] × 2.

Leda (Ledina) jonesi Gardner, new species

1896. *Yoldia eborea* Conrad. Harris, Bull. Am. Paleontology **1** (No. 4): 56, pl. 4, fig. 7 (ex parte).

1898. *Leda (Ledina) smirna* Dall, Wagner Free Inst. Sci. Trans. **3** (pt. 4): 578, 580 (ex parte).

Shell large for the genus, *Yoldia*-form, moderately heavy and well polished, smoothly and rather strongly inflated. Umbones submedial, obtuse but fairly prominent, the tips incurved and almost in contact. Lunule narrow, half as long as the anterior dorsal margin, defined by the smooth surface and the pinched margin. Escutcheon similar in general outline and surface to the lunule but longer and wider, more sharply delimited and extending more than two-thirds of the distance to the posterior extremity; both lunule and escutcheon framed by faint rays which are produced almost to the lateral margins. Anterior half of shell obliquely truncate dorsally, rounding laterally into the broadly arcuate base. Posterior half of shell constricted behind the umbones, relatively narrow but rounded at the posterior extremity. Outer surface smooth excepting for incrementals and a microscopically fine and regular concentric striation. Chondrophore small, trigonal, set deep beneath the umbones. Hinge teeth strong, taxodont, from 20 to 25 in both the anterior and the posterior series. Muscle scars rather obscure, the anterior larger and broader than the posterior. Pallial line inconspicuous, simple.

Dimensions.—Altitude, 13.6 millimeters; latitude, 27.1 millimeters; diameter, 10.9 millimeters.

[4] The line drawings were made by Miss Frances Wieser.

Holotype.—U. S. Nat. Mus. No. 371067.

Type locality.—Black Bluff, Tombigbee River, sec. 12, T. 16, R. 1 W., Sumter County, Alabama.

Leda jonesi is one of the most common species in the small Black Bluff fauna. Though well represented in the early collections, it was included under *"Yoldia eborea"* Conrad, later *Leda smirna* Dall. Harris (*op. cit.*, 56) noted, however, that "there is considerable variation in the size as well as the shape of this species. The Tombigbee River specimens are larger and longer than those from the Alabama River exposures." The larger size, less trigonal outline, more rounded posterior extremity, and less arcuate ventral margin are sufficiently distinctive to justify the separation of the Black Bluff species from *Leda smirna* of the Matthews Landing, Alabama River, fauna. The differences are significant, for Black Bluff offers the type section of the Sucarnoochee clay while Matthews Landing is the most highly fossiliferous outcrop of the overlying Naheola formation.

I have the pleasure of naming this species in honor of Dr. Walter B. Jones, the State Geologist of Alabama.

ZOOLOGY.—*Field notes and locality records on a collection of amphibians and reptiles chiefly from the western half of the United States. I. Amphibians.*[1]

CHARLES E. BURT and MAY DANHEIM BURT, American Museum of Natural History. (Communicated by LEONHARD STEJNEGER.)

During the course of an automobile tour through the western half of the United States, from June 10 to September 15, 1928, the opportunity was taken to collect as many amphibians and reptiles as the time allowed. The following account has been prepared in order to make the locality records obtained available to students of distribution and to put into permanent form the numerous field observations made during the course of the collecting. Every effort has been made to make the determination of species as accurate as possible, but critical taxonomic notes on details of coloration and scutellation have usually been omitted, since in most cases this type of information may best be given by subsequent revisers of the genera concerned.

The opportunity has been taken to include here a series of about forty specimens from the authors' personal collection.[2] All of the specimens here reported, with the exception of a number used in per-

[1] Received October 3, 1929.

[2] Records based on specimens not taken by the authors are associated with the names of the collectors.

sonal exchanges or as gifts to other institutions, are being deposited in the Museum of Zoology of the University of Michigan.

To a number of friends who have generously spent time in the field with us we extend our grateful appreciation. We are especially indebted to Mr. and Mrs. Oliver Millard of San Francisco; Mr. L. M. Klauber of San Diego; Dr. A. P. Williams of Neodesha, Kansas; Mr. W. H. Burt of the Museum of Vertebrate Zoology of the University of California; Mr. and Mrs. Earle M. Landholm of Bristow, Nebraska; and Mr. Howard Shaffer of Haddam, Kansas; likewise, to Dr. Frank N. Blanchard for his kind criticism of this work. Assistance has been obtained from the Museum of Zoology of the University of Michigan.

LIST OF SPECIES

SALAMANDERS

Ambystoma tigrinum (Green).—A large specimen of the tiger salamander, still in the larval state, was collected on Aug. 28 in the muck of a shallow roadside pond 3 miles southeast of Park City, Summit County, Utah.

An adult was found in a tub of rainwater on September 14 at a farm 8 miles north of Bristow, Boyd County, Nebraska, and another adult was observed on the floor of a cellar at the same place, but it escaped by going into an earthen tunnel at the side of the steps.

Batrachoseps attenuatus attenuatus (Eschscholtz).—Two of these little, pinkish salamanders were found on August 12 under rocks in the bed of a small streamlet which flows down the side of Mt. Diablo, Contra Costa County, California. Here, curled up in the damp sand and gravel, they resembled earthworms.

Several large specimens were obtained on August 13 under rocks in a fern bed which had been watered all summer at 217 Upper Terrace, San Francisco, San Francisco County, California.

TOADS

Bufo americanus Holbrook.—The males of this species were calling on June 12. Specimens were taken at the edge of the Vermillion River near La Salle, La Salle County, Illinois, and at Deer Park, 6 miles east of La Salle.

Bufo cognatus cognatus (Say).—Nine of these toads were found trapped in the stagnant water of an irrigation sluice 7 miles northwest of Tucson, Pima County, Arizona.

Bufo compactilis Wiegmann.—A large adult was collected on the muddy road at Nulo, El Paso County, Texas, just after a mountain shower which came late in the evening of July 16.

Bufo woodhousii Girard.—These toads are usually abundant where they occur and are easily taken on rainy days. However, when the sun shines they find shelter by burrowing in some damp location, preferably in sand or loose loamy soil, or by hiding beneath loose boards, fallen trees, logs, or other objects. They are frequently seen close to dwellings and in many places they are called "garden toads." The habit of coming from their retreats at night to hop on the road or to sit beneath a street light to catch the insects upon which they prey often results in their death, as evidenced by the number of their flattened bodies to be found at times on some of the main traveled highways.

At Bristow, Boyd County, Nebraska, where a bend of Ponca Creek has been cut off to produce the stagnant "Dead Creek," hundreds of transforming young, tailed to tailless, were observed on the night of June 16, and many were collected. They were particularly abundant on the extensive mud-flats which surrounded this cut-off, although many were on the masses of aquatic vegetation which floated upon the surface of the water. Adults were collected near these young as well as on the side-walks and in the gardens of Bristow. Specimens were also found in an orchard 2 miles to the northeast and along a roadside 5 miles to the north of town.

In Kansas, several specimens were taken at Blue Rapids in Marshall County, and both young and adults were secured on a farm 5 miles north of Haddam in Washington County on June 27, and again on a creek bank 3 miles northeast of Haddam on September 1. The young were all tailless and much larger on the second date. On the afternoon of April 30, 1927, many males were observed congregated in a temporary meadow pool near the Big Salt Marsh in Stafford County. This latter date is probably within the earlier days of the mating period.

Large specimens were taken on the road at Ft. Hancock, El Paso County, Texas, and 1 mile northwest of Canutillo (also in El Paso County). In the latter place they were less than 300 feet from the Rio Grande.

Frogs

Acris gryllus (Le Conte).—This little frog is very common in the middle west in the typical part of its range and frequents a great variety of habitats. Here it may be found at almost any place where there is permanent water—in springs, along water courses, at the edges of ponds, or in marshes, in either clear or muddy, and running or stagnant water. In most places cricket frogs are associated with *Rana pipiens*, although they sometimes occur alone, particularly in the vicinity of the smaller prairie springs. When in danger individuals usually attempt to escape detection by hiding under aquatic vegetation or debris, but at times they hop into some secluded spot upon the bank or upon a surface mat of algae, etc., where they remain perfectly motionless, relying solely upon their concealing coloration and their readiness to change their position for protection. There is remarkable variation in the dorsal ground color of these creatures, even in one locality—many shades and combinations of black, gray, brown, green and yellow being in evidence in large series of living individuals.

In Michigan, specimens were taken 8 miles west of Kalamazoo, Kalamazoo County. — In Illinois at Deer Park, 6 miles east of La Salle, La Salle County; and 10 miles northwest of Elizabeth, Jo Daviess County. — In Iowa, 3 miles southwest of Cedar Falls, Blackhawk County. — In Nebraska, 7 miles east of Brunswick and 2 miles north of Oakdale, Antelope County; Ponca Creek and "Dead Creek"[3] near Bristow, Boyd County; 10 miles south of Beatrice, Gage County; pool on right bank of the Niobrara River near the Bristow Dam and Riverside Park, northern Holt County; 7 miles west and a little south of Norfolk, Madison County; and 1 mile west of Osmond, and 8 miles south of Columbus, Pierce County. — In Kansas, 5 miles south of Clifton, Clay County; 4 miles northwest of Richmond, Franklin County; 2 miles west of Waterville, Marshall County; and from 6 miles east of Haddam, 6 miles north of Haddam, Nutch's Pond (2 miles east of Haddam), 4 miles southeast of Haddam, 7 miles southeast of Enosdale, Morrowville, and just west of Washington, in Washington County. — In Oklahoma, 16 miles north of Coalgate, Coal County; and Owen, Washington County. — In Texas, 7 miles south of Eola, Concho County; 5 miles southwest of Cove, Coryell County; 6 miles east of Rochelle, McCulloch County; and 2 miles south of Lorena, McLennan County.

[3] See mention of this creek under *Bufo woodhousii*, p. 428.

Hyla regilla Baird and Girard.—We took this frog only in San Francisco County, California, and only on the afternoon of August 19. At Lake Merced, near Ingleside, ten individuals were taken from the stems of reeds and rushes at the edge of the water.

A series of 87 specimens was secured in a short time along the banks and in the pools of Islais Creek, just below Mission Bridge, in San Francisco. This creek ordinarily carries a small amount of water and the flow is not rapid. At the point where our specimens were taken there was a rock bottom, but this was often covered over by mud. There were many side pools which were often covered by a combination growth of algae, moss, and duckweed, on the surface of which many frogs were found. Individuals often attempted to escape by diving below this mat of surface vegetation. Tadpoles were seen in the water and metamorphosing forms were found both in the water and out of it.

Down stream, a short distance below Mission Bridge, a sewer empties into Islais Creek, and below this point *Hyla* was not found. Here the aquatic vegetation becomes scanty, the water impure, and the bottom of the stream filled with a barren, black sludge, which is often of considerable depth.

Rana aurora draytonii (Baird and Girard).—Mr. Oliver Millard has sent us a specimen of this form which he collected at a small pond near a stream which flows into Lake Merced, near Ingleside, San Francisco County, California.

Rana boylii boylii (Baird).—On the road from San Rafael to Bolinas in Marin County, California, at a point about 6 miles west of San Rafael, four of these little frogs were found near a roadside spring from which a small streamlet of clear water trickled over a bed of stones and gravel.

Others were secured at the edge of Lake Merced, San Francisco County, California, in moist, but relatively open places. Here two methods of escape were observed: (1) Diving into the water and hiding there under the cover of aquatic vegetation, and (2) jumping into the thickets of land vegetation on the banks above the shore line.

Rana boylii sierrae Camp.—This subspecies was found to be abundant in the vicinity of a fair-sized mountain stream which runs alongside the road from Placerville to Lake Tahoe in Eldorado County, California, at a point about 40 miles west of Lake Tahoe. There was very little vegetation along the broad stream, which flowed moderately and with a depth varying from one to three feet. The bed of the

stream, easily seen through the clear water, was essentially of stones, gravel and sand. The frogs were usually resting at the water's edge, but they jumped into the water and hid under stones as we approached. A number were secured with the fingers after they had been pinned to the rocks under which they were seen to take refuge or after they had been trapped in some under-water crevice.

Mr. Oliver Millard has recently sent us a series of this form which he collected in the Sierra Nevada Mountains along a tributary of the north fork of the Stanislaus River at an elevation of 6500 feet, 15 miles northwest of Calaveras, Calaveras County, California.

Rana catesbeiana Shaw.—Bullfrogs are common along the banks of the larger ponds and streams of the middle west. They are not as widespread in their occurrence here as *Rana pipiens* and *Acris gryllus*, with which they are usually found. Specimens of *Rana catesbeiana* were taken at Nutch's Pond (2 miles east of Haddam), Washington County, and along the banks of the Verdigris River, 4 miles northeast of Neodesha, Wilson County, in KANSAS; and at Owen, Washington County, in OKLAHOMA.

Rana clamitans Latreille.—The green frog was taken only in Illinois. It was found near rather deep pools in Deer Park, 6 miles east of La Salle, La Salle County; and along a stream 10 miles northwest of Elizabeth, Jo Daviess County.

Rana palustris Le Conte.—An adult of this species was collected 10 miles northwest of Elizabeth, Jo Daviess County, Illinois, at the edge of a small, wooded stream, Smallpox Creek.

Rana pipiens Schreber.—The leopard frog is the most common amphibian of the middle west, due, perhaps, to its ability to adapt itself to a great variety of habitats and habitat conditions. It may occur in either clear or muddy water; in shallow ponds or in deep ones; in springs, in creeks or in rivers; and in the mountains or in the lowlands. Its distribution in the typical part of its range seems to be limited only by its ability to reach the permanent bodies of water.

When disturbed, individuals dive beneath aquatic debris, rush into clumps of reeds or sedges in the water, or seek shelter in the weeds or grasses of the bank. They seem to be much more wary in some localities than at others and are always harder to secure at the higher temperatures.

We have often noticed that after the mating season rain causes the amphibian population to spread out, whereas a continued dry period causes it to concentrate about bodies of water or in moist situations.

Thus, on June 27, but a short time after a rain, an adult *Rana pipiens* was found near Haddam, Kansas, high on a hillside above a pond; on June 30, after more rain, specimens were found in the woods, buck-brush, and prairie above a creek near Clifton, Kansas; and on July 16, just after a mountain shower, one was taken from a sandy road at Fort Hancock, Texas.

Two albino frogs of this species were collected with a dip net 3 miles south of Patagonia, Arizona, on July 20. In life these individuals were clear pink and many of their blood vessels could be readily seen. One was a large tadpole and the other was in the transforming stage. The external mouth parts of the tadpole were black, but those of the other albino were pinkish. Typical dorsal spots were present on the transforming specimen as perceptibly darker areas, edged with white.

In ILLINOIS, specimens were taken at La Salle, and in Deer Park, 6 miles east of La Salle, La Salle County. — In IOWA, 3 miles southeast of Cedar Falls, Blackhawk County. — In NEBRASKA, 7 miles east of Brunswick, Antelope County; Bristow, "Dead Creek"[4] and 5 miles northeast of Bristow, Boyd County; 10 miles south of Beatrice, Gage County; pool on right bank of the Niobrara River near Bristow Dam and Riverside Park, northern Holt County; 1 mile east of Osmond, Pierce County; and 8 miles south of Columbus, Platte County. — In KANSAS, 4 miles south of Clifton, Clay County; 4 miles northwest of Richmond, Franklin County; 2 miles west of Waterville, Marshall County; 3 miles east of Prairie View, Phillips County; 6 miles east of Haddam, 6 miles north of Haddam, 3 miles northeast of Haddam. 5 miles southeast of Haddam, 1 mile west of Haddam, Nutch's Pond (2 mi. east of Haddam), just north of Morrowville, 2 miles east of Strawberry, and Washington, Washington County; and Verdigris River, 4 miles northeast of Neodesha, Wilson County. — In TEXAS, Ft. Hancock, El Paso County; 2 miles northwest of Toyahvale, Reeves County; and 2 miles southwest of Big Lake, Tom Green County. — In ARIZONA, 3 miles southwest of Patagonia, Santa Cruz County. — In COLORADO, 3 miles northwest of Deertrail, Arapahoe County; 3 miles east of Denver, Denver County; 2 miles east of Flagler, Kit Carson County; and Bear River, 9 miles east of Craig, 1 mile north of Hayden, 1 mile northwest of Steamboat Springs, and 5 miles northwest of Steamboat Springs, Routt County. — In UTAH, 3 miles southwest of Park City, Summit County; and 4 miles east of Fort Duchesne. Uintah County.

[4] See mention of this creek under *Bufo woodhousii*, p. 428.

ZOOLOGY.—*A new antelope squirrel from Arizona.*[1] E. A. GOLDMAN, Bureau of Biological Survey.

Further study of the mammals of Arizona has resulted in the detection of a hitherto unrecognized antelope squirrel in the Grand Canyon of the Colorado River. The new form is of considerable interest in tracing the distribution of species in that remarkable region. It is described subspecifically as follows:

Ammospermophilus leucurus tersus, subsp. nov.

Grand Canyon Antelope Squirrel

Type.—From lower end of Prospect Valley, Grand Canyon, Hualpai Indian Reservation, Arizona (altitude 4,500 feet). No. 202645, ♂ young adult, U. S. National Museum (Biological Survey collection), collected by E. A. Goldman, October 3, 1913. Original number, 22269.

Distribution.—Terraces along the southern side in Grand Canyon, on the Hualpai Indian Reservation, Arizona. Upper Sonoran Zone.

General characters.—Resembling *Ammospermophilus leucurus cinnamomeus*, but smaller; color usually darker, the sides of body below white stripes more heavily mixed with black; skull with distinctive details, especially the lighter dentition. Similar in size to typical *A. l. leucurus*, but color much darker, the back less heavily overlaid with gray; skull essentially as in *leucurus*.

Color.—*Type* (anterior half of body in worn summer pelage, posterior half acquiring winter coat): Top of head, neck, shoulders, and anterior part of back light cinnamon brownish, mixed with gray, the brownish element predominating on head; posterior part of back, rump and outer sides of hind limbs near mikado brown, finely and rather inconspicuously mixed with white; sides of body below usual white stripes near mikado brown, moderately mixed with black; under parts, including inner sides of limbs, white; outer sides of forearms light pinkish cinnamon, this color passing down and gradually fading out on toes of forefeet; upper surface of hind feet dull white, tinged along outer side with light pinkish cinnamon; tail above mikado brown at base, thence mixed black and white, the lateral margins and extreme tip pure white, below white, with a conspicuous, subterminal black band.

Skull.—About like that of *A. l. leucurus*, but rather small, with narrow nasals, and narrow interorbital space. Similar to that of *A. l. cinnamomeus*, but smaller; dentition lighter; molariform toothrows decidedly shorter.

Measurements.—*Type:* Total length, 208 mm.; tail vertebrae, 67; hind foot, 38.5. Average and extremes of nine full grown males and females, including type, from type locality: 204 (194–214); 62 (54–72); 39 (38–40); *Skull* (type): Greatest length, 37.6; condylobasal length, 34.8; zygomatic breadth, 22.2; breadth of braincase (at notch behind zygomata), 18.1; interorbital breadth, 9.2; least postorbital breadth, 13.5; length of nasals, 10.6; maxillary toothrow, 6.3.

Remarks.—In the Grand Canyon of the Colorado River, which bisects the high plateau region of northern Arizona, antelope squirrels are restricted mainly to the broader terraces bordering the inner gorge. These terraces are

[1] Received October 3, 1929.

cut at frequent intervals by side canyons, some of which extend with sheer walls to the nearly or quite precipitous outer rim of the main canyon. The higher parts of the Coconino Plateau along Grand Canyon are unsuited to the needs of antelope squirrels and the side canyons mentioned, while not absolute barriers at their heads, evidently tend to break the continuity of range within the main canyon.

Specimens from Indian Gardens, on the broad terrace along the inner gorge at 3,800 feet altitude on the south side near the end of the Grand Canyon Railroad, are darker and richer in color than typical *A. l. cinnamomeus* and may be grading toward the form here described, but in cranial characters agree with the former. Some specimens from localities in northwestern Arizona, north of the Grand Canyon are similar to the Prospect Valley animal in cranial details and are not widely different in color, but are evidently more nearly intermediate between *A. l. leucurus* and *A. l. cinnamomeus.* The restricted range of *A. l. tersus* is closely approached on the west, beyond the Grand Wash Cliffs, by the wide distribution area of *Ammospermophilus harrisii*, a related but apparently quite distinct species. The narrow gap between the known ranges of the two has not been thoroughly explored, but appears to be a barrier formed by high spurs of the plateau, extending to sheer or uninhabitable canyon walls.

Specimens examined.—Ten, all from the type locality.

ZOOLOGY.—Neoaplectana glaseri, *n.g., n.sp. (Oxyuridae), a new nemic parasite of the Japanese beetle* (Popillia japonica *Newm.*).[1]

G. Steiner, Office of Nematology, Bureau of Plant Industry.

In a lot of fourteen dead larvae of the Japanese beetle[2] submitted to him for a diagnosis as to the cause of the death, Dr. R. W. Glaser of the Rockefeller Institute for Medical Research at Princeton, N. J. found thousands of nemas. These were sent to the writer for identification.

The form seems to be new, belonging not only to a new species but also to a new Oxyurid genus exhibiting close relationship to the genera *Aplectana* and *Steinernema.* The present paper deals only with the description of the new form; the life cycle and economic significance of the parasite will be studied by Dr. Glaser himself. It is the first time, so far as we know, that a nema has been observed parasitizing the Japanese beetle. The question as to the origin of this parasite also is of interest. Is it a native of Japan? Was it brought to this coun-

[1] Received October 9, 1929.

[2] Kindly sent by Dr. Henry Fox, of the U. S. Japanese Beetle Laboratory at Moorestown, N. J.

try with the first immigrating Japanese beetle, or did it come later with the introduction of some other parasites of its host in an accidental way? This is not known. Another possibility is that the parasite has as an original host some native insect or insects, and adapted itself only recently to the Japanese beetle. It would be strange if this parasite had in the past escaped the efforts of the numerous entomologists studying that insect, and has only now come to their attention. The view that we have here a case of an attack of some native parasite on the immigrant therefore seems more probable. Dr. Glaser states that the larvae of the beetle were swarming with specimens of the parasite, larvae as well as adult males and females.

Neoaplectana glaseri, n. g., n. sp.

The larval Neoaplectanas are very slender, in a less degree also the males, but the females are thick and plump. The tail end of the larva is long-conical and sharply pointed (Fig. F); that of the female, however, is short-conical with a blunt end (Fig. G). The tail of the male is different, being broad-obtuse (Figs. H and I). The cuticle is thin, not annulated and not striated. There are no lateral wings, a character which differentiates this genus from *Aplectana* (Railliet et Henry, 1916). No deirids but phasmids were seen. The head is not set off. There are three indistinct lips; each of them has two protruding papillae, all together forming an anterior or labial circle of papillae. Back of them, however, is a second circle of papillae,—the cephalic papillae,—which do not protrude. They are difficult to see in a side view, and are best located in a front view. The amphids are perhaps the most noticeable organs of the head end. They are shifted dorsad to the same level with the lateral papillae. The amphidial pouch is a slightly conical tube (Fig. B); terminals were seen but their number could not be made out. Two short setae were seen ventro-submedial, one on each side at about the level of the cephalic papillae. Their significance is unknown (Fig. E). There is no buccal cavity. The anterior part of the oesophagus is cylindroid; a faint isthmus connects with the terminal bulb. At the anterior end of the oesophagus the outlets of three salivary glands were seen. The terminal bulb is rather weak and the ribbed valvulae are indistinct. The intestine consists of a single layer of flat cells. In the larvae, these are filled with granules, except three or four cells just following the oesophageal bulb. In the adult, however, the intestine seems degenerate. The nerve-ring circles the oesophagus in front of the terminal bulb. The excretory pore opens ventrad of the nerve-ring. The female sexual apparatus is amphidelph (Seurat 1920). The ovaries are apparently reflexed. The uterus extends far forward and backward, often reaching and even passing the terminal bulb of the oesoph-

agus. Larvae and eggs in all different stages of cleavage are seen simultaneously in the uterus. Perhaps the present species represents a case closely approaching what Seurat (1920) terms "endothokis matricide." It is very probable that most of the larvae hatch only after the mother is dead. The male has a single testis, stretched out forward but ending some distance behind the beginning of the intestine. The entire male apparatus has a right lateral position. Only the end portion of the ductus ejaculatorius lies ventrad. The spicula are large and arcuate, the distal end is slightly cephalated and forms a hook; the gubernaculum is large, its distal part lineate, the proximal, however, broadly swollen (Fig. H). The arrangement of the muscles of the male apparatus may be seen in Fig. H. The number of the protruding and nipple-shaped copulatory papillae is large. There are postanal and preanal papillae. There is a single preanal ventro-medial papilla some distance in front of the anus. A series of seven ventro-submedial papillae, beginning at the anus, extends about three and one-half times the length of the spicula in front of it; a single lateral papilla is located just in front of the anus. On the tail there are always two ventro-submedial papillae close to the end and a dorso-submedial one in the same region; in some specimens one or two additional ventro-submedial papillae were seen.

It will be noted from this description that the present form exhibits a close relationship to *Steinernema kraussei* (*Aplectana kraussei* Steiner 1923). The general shape of the body, but especially the spicula and the gubernaculum, are almost the same, yet the number and arrangement of the head sense organs are very different, *Steinernema* having but a single circle of four submedial papillae, whereas *Neoaplectana* has two circles of six each. In addition, the number of male copulatory papillae is much larger in *Neoaplectana* and their arrangement is very different. *Aplectana*, on the other hand, has lateral wings and a pointed tail end in the male, characters in which it differs from the present genus.

Neoaplectana belongs ecologically, probably, to a group of nemas, the hosts of which are insects that pass at least part of their life in the soil.

A. Anterior end. *p ex*, excretory pore; *valv*, valvula of terminal bulb. About 533×.

B. Sketch of the amphid. *amph gl*, amphidial gland; *amph p*, amphidial pouch; *term*, terminals.

C, D. Formed contents as seen in the intestine.

E. Front view of head end. *amph*, amphid; *dors subm lab pap*, dorso-submedial labial papilla; *lat cph pap*, lateral cephalic papilla; *seta*, seta of unknown significance. About 1090×.

F. Tail end of larva. *phas*, phasmid. About 120×.

G. Tail end of adult female. About 120×.

H. Tail end of male. *1–14*, various papillae; *brs msc*, bursal muscles; *dct ej*, ductus ejaculatorius; *prot gub*, protractor gubernaculi; *prot sp*, protractor spiculi; *retr gub*, retractor gubernaculi; *retr sp*, retractor spiculi. About 485×.

I. Tail end of male, ventral view. About 533×.

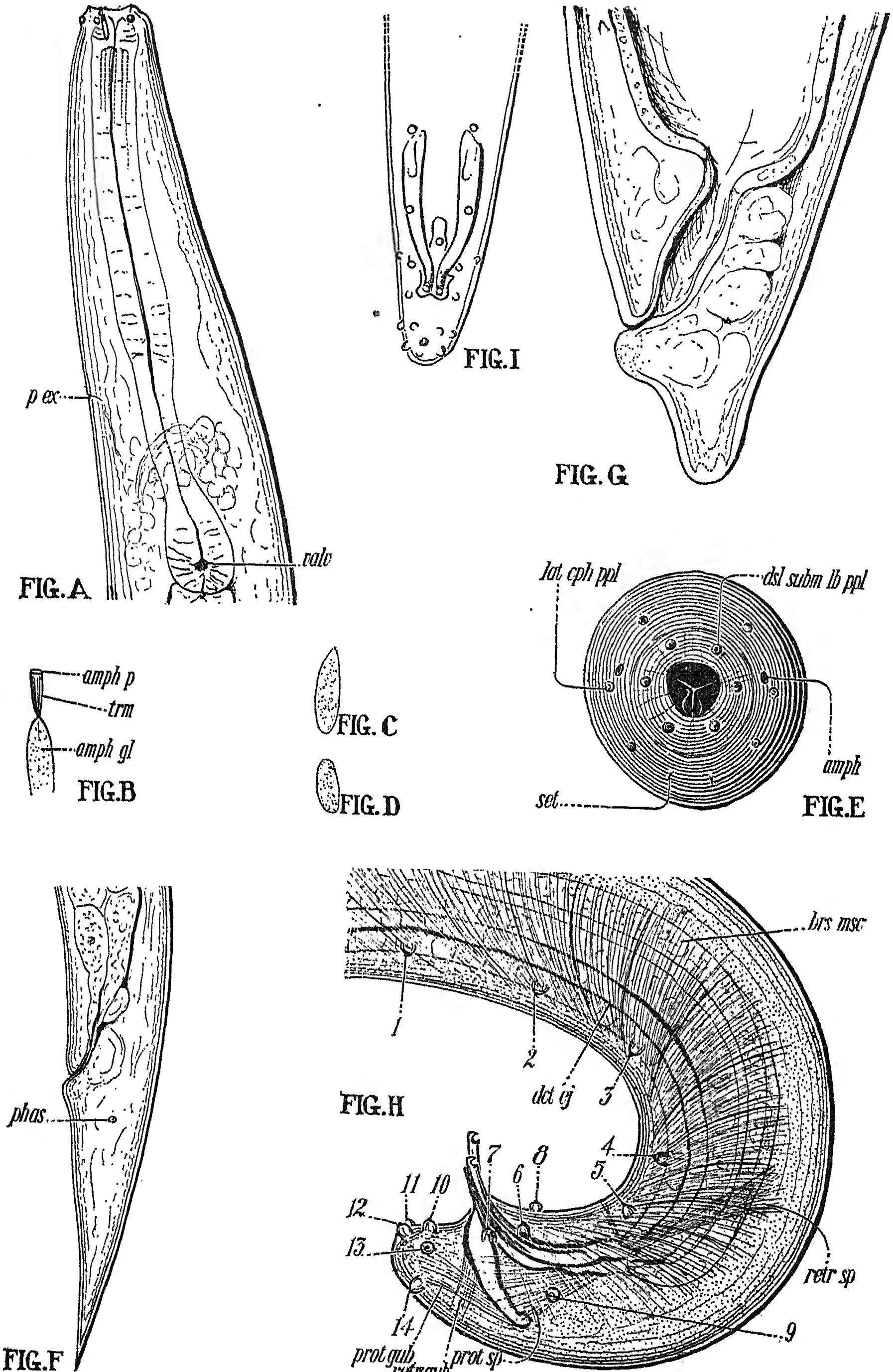

Figure 1.—*Neoaplectana glaseri*, n. g., n. sp.

Measurements:

	Nerve-ring	Oesophagus	Vulva		
?	2.3	3.9	$^{45}-51.5-^{44}$	98.8	4.7 mm.
?	1.8	2.2	4.4	1.4	
?	9.5	16.7	—M	96.7	1.4 mm
?	4.4	5.3	6.6	4.4	

Diagnosis of the genus. Oxyuridae without lateral wings, with three lips, six labial and six cephalic papillae; amphids shifted dorsad and forward to about the same level with the cephalic papillae. No bucal cavity, no mouth armature, oesophagus with slight isthmus in front of terminal bulb; the latter with vestigial valvulae; vulva in about the middle of the body; female apparatus amphidelph; male tail short, bluntly rounded; testis single; spicula symmetrical; gubernaculum single, large; numerous nipple-shaped preanal and postanal papillae in ventro-medial, ventro-submedial, lateral and dorso-submedial position.

Diagnosis of the new species. Neoaplectana with the characters of the genus; male with a single medial preanal papilla and with 11–13 ventro-submedial, lateral and dorso-submedial papillae on each side, as shown at II.

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SCIENTIFIC NOTES AND NEWS

Dr. RAY S. BASSLER has been appointed Head Curator of the Department of Geology in the U. S. National Museum to succeed the late Dr. George P. Merrill. Dr. Bassler has been connected with the Division of Paleontology of the Museum since 1901.

Dr. WILLIAM F. FOSHAG has been made Curator of the Division of Mineralogy and Petrology in the U. S. National Museum. Under this division is now included the former Divisions of Physical and Chemical Geology and of Mineralogy and Petrology.

Dr. C. E. RESSER, of the U. S. National Museum, has returned from a three months' field trip, mostly in the Rocky Mountains of Montana. Good collections of fossils and important stratigraphic information were obtained in furtherance of his studies on the lower Paleozoic formations.

ELLSWORTH P. KILLIP, Associate Curator of Plants in the U. S. National Museum, and his associates, ALBERT C. SMITH and WILLIAM J. DENNIS, report the collection up to August 1 of some 5400 numbers of plants from little known parts of Peru. The expedition left Lima April 15, collected at altitudes of 3000 to 4700 meters in the Departments of Lima, Junín, and Ayacucho, particularly in the regions of Tarma and Huancayo. Later work has been confined to the eastern slopes of the Andes at low and intermediate elevations. In October the party left Iquitos for Pará, and is expected to reach Washington about the middle of December. The collections will be of especial value not only for the addition of material from new regions but also for the topotypic material it contains of species hitherto imperfectly known and scantily represented in American herbaria. The work of the party has been expedited at all times by officials of the Peruvian government.

Dr. REMINGTON KELLOGG, of the Division of Mammals, and Mr. NORMAN BOSS, of the Division of Vertebrate Paleontology of the U. S. National Museum, are spending about a month in western Alabama collecting fossil mammals. The work is being carried on as a coöperative project under the auspices of the Carnegie Institution and the National Museum.

Dr. RALPH T. K. CORNWELL, formerly Assistant Professor of Organic Chemistry at the University of Pittsburgh, is now Senior Microanalyst in the Division of Chemistry at the Hygienic Laboratory, U. S. Public Health Service.

Dr. A. J. WATTERS of the University of St. Andrews, Scotland, is at the Hygienic Laboratory in the Division of Chemistry, under a Commonwealth Fund Fellowship.

Dr. RAYMOND M. HANN, formerly of the Department of Agriculture and Mellon Institute is now at the Hygienic Laboratory in the Division of Chemistry, engaged in sugar researches.

Dr EDWARD P. BARTLETT has resigned from the Fixed Nitrogen Laboratory, Bureau of Chemistry and Soils, Department of Agriculture, to become associated with the Du Pont Ammonia Corporation.

Mr. KNOWLES A. RYERSON, in charge of the Office of Foreign Plant Introduction, Bureau of Plant Industry, Department of Agriculture, has returned from a plant-collecting trip in Manitoba and Saskatchewan, Canada. Material of several native fruits and ornamental plants was obtained, and will be tested out at stations of the Department and elsewhere.

Mrs. AGNES CHASE, of the Bureau of Plant Industry, left New York October 19th for Rio de Janeiro, where she will be joined about 10 days later by Mrs. YNES MEXIA of the California Academy of Sciences. Mrs. Chase will devote herself to study and collection of grasses, while Mrs. Mexia will make a general collection. They plan to work westward mostly through the campo country of Minas Geraes, Goyaz, and Matto Grosso to Cuyaba.

Dr. H. B. HUMPHREY, a plant pathologist in the Department of Agriculture, has been elected president of the Botanical Society of Washington for the coming year.

Dr. Samuel Palkin of the Office of Drug Control, of the Food, Drug and Insecticide Administration, Department of Agriculture, has been transferred to the Industrial Farm Products Division of the Bureau of Chemistry and Soils, in the same Department, to carry on fundamental research on turpentine and rosin.

Dr. William S. Franklin, since 1917 professor of physics at the Massachusetts Institute of Technology, has become professor of physics at Rollins College.

The Educational Courses of the Bureau of Standards, which began on September 30, comprise courses in theoretical mechanics, theory of functions, integral equations and allied topics, introductory atomic physics, chemical mathematics, the theory of probabilities and its applications, and ceramic petrography.

The Graduate School of the Department of Agriculture opened on October 21, courses being offered on composition of the soil, fundamentals of chemistry, colloid chemistry, control of plant diseases, plant genetics, advanced statistical methods, history of American agriculture, prices and price relationships, principles of taxation, and economic aspects of weather and agriculture. Undergraduate courses are being given on elementary statistical methods, principles of systematic botany, agricultural writing, Spanish, and scientific French.

William H. Jackson, pioneer photographer of the Union Pacific Railroad and the United States Geological Survey under Hayden, though now well along in his 80's, has been engaged the past summer in locating parts of the exact course of the old Oregon Trail, along many miles of which he walked, photographing Indians and natural features, before the advent of the transcontinental railroads.

Yale University is putting up a building to house the Institute of Human Relations, in which scientific studies will be made of child development, mental reactions, psychology, motivation, social relations and similar matters pertaining to human welfare.

With the probability that further large oil pools exist at greater depths than have heretofore been drilled, and with present shut-in reserves, the advances in chemical technology by which more gasoline is produced from the same quantity of crude, and the facility with which one kind of fuel can be transformed into another, the possibility of a shortage of gasoline now seems rather remote.

The principal industrial disease in South Africa, according to Prof. W. E. Dixon's statement before the British Association for the Advancement of Science, is silicosis—brought about by inhaling silica dust in the gold mining districts. The mode of action of the silica is not well understood, but it seems to promote tuberculosis and Bright's disease.

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CHEMISTRY.—*Some physical constants of* d-*gluconic acid and several of its salts.*[1] Orville E. May, Samuel M. Weisberg and Horace T. Herrick, Bureau of Chemistry and Soils. (Communicated by Edgar T. Wherry).

During an investigation of the action of fungi on solutions of dextrose it was found that an organism belonging to the *Penicillium luteum-purpurogenum* group was capable of oxidizing dextrose to *d*-gluconic acid in good yields.[2] With a proper concentration of dextrose and inorganic nutrient salts and at temperatures in the region of 25°C. yields of *d*-gluconic acid up to 65 per cent of the theoretical were consistently obtained.[3] Because of the possibility of this acid attaining commercial importance, it was thought advisable to investigate the properties of some of its salts. A review of the literature revealed a great deal of contradiction concerning the composition and physical properties of these compounds.[4]

Few solubility data are recorded, and the degrees of hydration and the specific rotations reported for the different salts vary widely. Accordingly, several representative salts of *d*-gluconic acid were prepared and carefully purified. They were analyzed for hydrogen and cation, and specific rotation and solubility were determined. The results of these experiments are recorded in the accompanying table.

The salts were prepared either by neutralizing the acid directly with the carbonate of the metal or by treating a hot solution of barium

[1] Received October 29, 1929.

[2] O. E. May, H. T. Herrick, C. Thom, and M. B. Church. Journ. Biol. Chem. **75**: 417. 1927.

[3] H. T. Herrick and O. E. May. Journ. Biol. Chem. **77**: 185. 1928.

[4] For a brief summary see: *Chemie der Zuckerarten*, by E. O. von Lippmann. 310–314. Braunschweig, 1904.

gluconate with the calculated amount of the sulfate of the metal. They were all recrystallized at least three times from water-ethanol solutions and were dried in a vacuum desiccator over calcium chloride, some at room temperature and the others at higher temperatures. The hydrogen determinations were made by combustion of the salts in the apparatus designed by Phillips and Hellbach.[5] The methods of analysis for the cations are given in the table.

In the determination of specific rotations three grams of the salt was dissolved in enough distilled water to make 100 ml. at 20°C. The anhydrous salts, with the exception of magnesium and zinc gluconates, were used in this measurement. A 2 dm. tube was employed, and the measurements were made in a sensitive saccharimeter. The specific rotations reported in the table are for light passed through a dichromate filter and therefore, strictly interpreted, are not referred to the D line of sodium. The formula employed in the calculations of the specific rotation from the saccharimeter reading was $(\alpha)^{20} = \frac{100\ (0.3465\ a)}{6}$, where a is the observed reading.

The solubility measurements were carried out by shaking an excess of the salt with distilled water for at least 24 hours in a carefully regulated thermostat at 25°C. The trihydrates of the magnesium and zinc salts were used for these measurements. Immediately after stopping the agitation of the containers in the thermostat, the solutions were rapidly filtered, and an accurate portion was taken for analysis by means of a calibrated pipette. Analysis was then made for the cation by the method indicated in the table. The results given in the table are the averages of at least two determinations.

When obtained by crystallization from water-ethanol solutions and dried in vacuum desiccator over calcium chloride at room temperature the salts included in the table became anhydrous, with the following exceptions:—barium gluconate, $Ba(C_6H_{11}O_7)\cdot H_2O$; magnesium gluconate, $Mg(C_6H_{11}O_7)_2\cdot 3H_2O$; nickel gluconate, $Ni(C_6H_{11}O_7)_2\cdot 3H_2O$; and zinc gluconate, $Zn(C_6H_{11}O_7)_2\cdot 3H_2O$. The barium salt obtained from water-ethanol solution by crystallization and air drying between dry filter papers for two hours lost 9.24 per cent of its weight on being heated in the oven at 105°C. for two hours. The calculated loss for three molecules of water is 9.29 per cent. When allowed to stand in a constant temperature room at 25°C. the air dried salt slowly lost water

[5] M. Phillips and R. Hellbach. Journ. Assoc. Offic. Agric. Chem. 11: 393. 1928.

TABLE 1.—SOME PHYSICAL CONSTANTS OF THE SALTS OF GLUCONIC ACID

Salt	Analysis: Theoretical	Analysis: Actual	Parts by weight in 100 ml. of solution at 25°C.	$(\alpha)^{20°}_{D}$	Methods of analysis
Sodium gluconate $NaC_6H_{11}O_7$	5.08% H 10.54% Na	5.00% H 10.44%, 10.42% Na	46.1 46.1	10.3	Na determined as sodium sulfate
Potassium gluconate $KC_6H_{11}O_7$	4.80% H 16.69% K	4.74% H 16.63%, 16.65% K	50.7 51.0	10.3	K determined as potassium sulfate
Ammonium gluconate $NH_4C_6H_{11}O_7$	7.23% H 6.57% N	7.08% H 6.48%, 6.48% N	30.0 29.8	11.8	N determined by Kjeldahl-Gunning-Arnold method
Barium gluconate $Ba(C_6H_{11}O_7)_2 \cdot H_2O$	4.44% H 25.20% Ba	4.46% H 25.33%, 25.30% Ba	8.7 8.7	9.0	Ba determined as the sulfate
Calcium gluconate $Ca(C_6H_{11}O_7)_2$	5.15% H 9.31% Ca	5.21% H 9.25%, 9.23% Ca	3.9 3.8	9.8	Ca determined as calcium oxide
Magnesium gluconate $Mg(C_6H_{11}O_7)_2 \cdot 3H_2O$	5.19% Mg	5.17%, 5.13% Mg	7.8 7.8	9.9	Mg determined as the pyrophosphate
Nickel gluconate $Ni(C_6H_{11}O_7)_2$	4.83% H 13.08% Ni	4.81% H 12.97%, 12.92% Ni	9.6 9.7	−0.5	Ni determined as the glyoxime compound
Manganese gluconate $Mn(C_6H_{11}O_7)_2$	4.98% H 12.34% Mn	4.77% H 12.32%, 12.29% Mn	16.8 16.8	10.1	Mn determined as the pyrophosphate
Zinc gluconate $Zn(C_6H_{11}O_7)_2 \cdot 3H_2O$	5.54% H 12.83% Zn	5.34%, 5.34% H 12.72%, 12.82% Zn	12.7 12.7	9.0	Zn determined as the pyrophosphate
Lead gluconate $Pb(C_6H_{11}O_7)_2$	3.71% H 34.70% Pb	3.64% H 34.61%, 34.77% Pb	5.1 5.1	−7.2	Pb determined as the chromate

of crystallization so that at the end of a week it contained 4.03 per cent water, indicating that in time it probably would completely give up two molecules of water. On heating the air dried salt in the oven at 65°C. for two hours a sample was obtained which contained 25.30 per cent barium. The theoretical content of barium for the salt containing one molecule of water is 25.20 per cent. The salt on being heated at 105°C. lost 2.95 per cent of its weight, whereas 3.30 per cent is the theoretical loss for one molecule of water. These results agree with those of Herzfeld,[6] and the conclusions are that the freshly crystallized salt is a trihydrate which slowly goes over to the monohydrate on standing, the speed of the transformation depending on the temperature and humidity.

When the magnesium salt is dried in a desiccator over calcium chloride it apparently contains three molecules of water to which it clings tenaciously. On analysis 5.17 per cent and 5.13 per cent Mg was found, calculated for $Mg(C_6H_{11}O_7)_2 \cdot 3H_2O$, 5.19 per cent. When dried to incipient decomposition at 105°C. it was found to contain 5.24 per cent of the metal, indicating that little or no water had been lost. These results are similar to those reported by Stoll,[7] who found that little water was lost on heating this salt at 98°C. under low pressures. The hydrogen determinations on this compound were unsatisfactory for some reason not fully apparent. Repeated determinations on two different samples of this salt gave average values of 5.46 per cent and 5.48 per cent of hydrogen; calculated for $Mg(C_6H_{11}O_7)_2 \cdot 3H_2O$, 6.02 per cent. The hydrogen determinations on the other salts were in excellent agreement with theory in most cases, as will be noted in the table.

The nickel gluconate when dried in the desiccator in the usual manner contained three molecules of water of crystallization. Found 11.45 per cent and 11.47 per cent nickel; calculated for $Ni(C_6H_{11}O_7)_2 \cdot 3H_2O$, 11.67 per cent. After drying for two hours at 105°C. this salt still retained some water of crystallization. At a temperature of 90°C., however, and a pressure of 20 mm. of mercury, it became completely anhydrous. Found, 12.97 per cent and 12.92 per cent nickel; calculated for $Ni(C_6H_{11}O_7)_2$, 13.08 per cent.

The zinc salt also contains three molecules of water when dried in a desiccator over calcium chloride. Found, 12.72 per cent and 12.82 per cent zinc; calculated for $Zn(C_6H_{11}O_7)_2 \cdot 3H_2O$, 12.83 per cent. This

[6] HERZFELD. Ann Chem. **220**: 344. 1893.
[7] A. STOLL. U. S. Patent 1,648,368. 1927.

compound was unstable when heated, turning a dark brown color at 90°C., and was not obtained in the anhydrous condition.

The degree of solubility of the salts in water increases rapidly with rise in temperature, all being extremely soluble in hot water. The gluconates investigated formed supersaturated solutions very readily and some were maintained in that condition for several weeks.

The pronounced levo-rotation of lead gluconate and the feeble optical activity of the nickel salt were quite unexpected and no rational explanation for their behavior has been worked out. Each determination was repeated several times, using carefully purified materials. Furthermore, sodium gluconate solutions, freshly made from the levo-lead gluconate, always gave optical rotations corresponding to the usual values for the sodium salt.

Attempts to prepare crystalline *d*-gluconic acid following the procedure outlined by Rehorst[8] were not entirely successful. In most cases the product obtained was contaminated with varying quantities of lactone and in no case was the yield as high as was expected. A small amount of the crystalline material was isolated, however, and the following determination of its specific rotation was made within 5 minutes after the acid was dissolved. C = 0.5 $(\alpha)_D^{20} = -2.5°$. After 30 min., $(\alpha)_D^{20} = +7.3°$.

The dissociation constant of the free acid was calculated from potentiometric measurements of the pH of freshly prepared .08 N and .0004 N acid solutions. The number of determinations was limited by the small amount of crystalline material available. The following equations were utilized:

$$\mathrm{pH} = \log \frac{1}{(\mathrm{H})}. \quad \frac{(\mathrm{H}) \times (C_6H_{11}O_7)}{(C_6H_{12}O_7)} = \mathrm{K}.$$

The .08 N solution of the acid had a pH of 2.40, whence:

$$(\mathrm{H}) = .004, \text{ and } \mathrm{K} = (.004)^2/.076 = 2.1 \times 10^{-4}$$

The .0004 N solution of the acid had a pH of 3.78, whence:

$$(\mathrm{H}) = .000166, \text{ and } \mathrm{K} = \frac{(.000166)^2}{.000234} = 1.2 \times 10^{-4}$$

An average of these two values gives K = 1.65×10^{-4} which is comparable to the primary dissociation constants of malic and citric acids.

Summary.—Ten representative salts of *d*-gluconic acid were prepared and purified. The analysis, degree of solubility in water at 25°C., specific rotation, and degree of hydration of these salts are tabulated. The specific rotation and dissociation constant of *d*-gluconic acid are reported.

[8] K. Rehorst. Ber. deutsch. Chem. Ges. 61: 163. 1928.

ZOOLOGY.—*Field notes and locality records on a collection of amphibians and reptiles chiefly from the western half of the United States. II. Reptiles.*[1] CHARLES E. BURT AND MAY DANHEIM BURT, American Museum of Natural History. (Communicated by LEONHARD STEJNEGER.)

LIZARDS

Dipsosaurus dorsalis dorsalis (Baird and Girard).—A relatively small individual was found near a railroad track in a flat, hot, barren, sandy strip of desert wasteland 1 mile south of Red Rock, Pinal County, Arizona. When disturbed the animal moved from the cover of one desert bush to another with lightning like rapidity and it was shot only after an extended pursuit.

On the right bank of the Colorado River, in Imperial County, California, and just across from Yuma, Arizona, these lizards were particularly abundant. Here the river supports considerable vegetation in spite of its very fine, sandy soil and its proximity to the great sand dunes of the region. Just after we had crossed the interstate bridge we noticed some large brush heaps and a number of fallen trees by the roadside. Upon investigation we found that nearly every log or brush pile sheltered one or more of these keel-backed lizards. Although startled ones usually took shelter in some convenient hole, ten specimens (including some large adults) were collected here in a short time. Many escaped since attempts to dig individuals from their underground retreats failed in every instance but one.

Crotaphytus collaris (Say).—In KANSAS, many collared lizards were seen as they were quietly sunning themselves on the rocks of a large limestone quarry about noon on July 9, near Little Bear Mound at Neodesha, Wilson County. In OKLAHOMA, an adult male was found scampering over the flat rocks which were lying along the banks of a thinly wooded upland wash 8 miles south of Calvin, Hughes County. It ran a short distance on its hind feet. In TEXAS, 2 miles east of Rochelle, McCulloch County, a large male was found on a rocky ledge in a semi-arid section. A rocky, mountainous area proved to be the ARIZONA habitat of a collared lizard which was very inactive when discovered under a flat rock at 6:30 A.M. on July 20, at a point 14 miles south of Tombstone, Cochise County.

[1] Received October 3, 1929. The first instalment of the article appeared in THIS JOURNAL **19**: 428–434. 1929.

Crotaphytus wislizenii Baird and Girard.—A single leopard lizard was taken from a low tract of sandy ground in the Valley of the Rio Grande, 1 mile northwest of El Paso, El Paso County, Texas, where there were many large clumps of mesquite.

Callisaurus ventralis ventralis (Hallowell).—These lizards were taken at various places in southern Arizona in desert areas of much loose sand and sparse vegetation. The relative openness of the habitat chosen is apparently correlated with behavior since these creatures seem to prefer to run around, rather than into, the existing vegetation. They often run for surprisingly long distances when disturbed and it is because of the length, swiftness and directness of their movement, and the suddenness with which it ends, that one often loses sight of a much desired specimen. A clump of desert grass, a rock, or some brush usually serves as a protection for an individual that has ended its flight, since these, like most other desert reptiles, apparently possess an instinctive knowledge of the value of such objects for concealment. While being stalked an individual often raises its head as high as the length of its front legs will permit in order that it may better watch its supposed pursuer. This movement sometimes serves as the sole indication of the lizard's presence in the vicinity of a particular bush or rock and it may be stated here that this species is about the most inquisitive lizard that we have observed.

The sexual dimorphism of this form is very striking. In July at least, the female has smaller femoral pores and a general ventral coloration of spotless white, broken only by the dark sub-caudal and latero-ventral bars (which are much less black than in the male) and by a distinctive tinge of light yellow on the sides of the abdomen and at the base of the tail. The male, on the other hand, has enlarged femoral pores, distinctive deep black sub-caudal and latero-ventral bars, and a slaty gular region. A patch of bright blue or green surrounds the latero-ventral bars and much orange is present behind the forearms. The base of the tail is usually colored as in the female.

Specimens have been taken 2 miles northwest of Casa Grande, 1 mile northwest of Casa Grande, 6 miles southeast of Maricopa, and 5 miles southeast of Maricopa, in Pinal County, Arizona; 10 miles east of Yuma, Yuma County, Arizona; and on the right bank of the Colorado River, just across from Yuma, Arizona, in Imperial County, California.

Holbrookia maculata approximans (Baird).—The habitat of certain of these swifts at Cambray, Luna County, New Mexico, proved to be a

level desert plain on the loose, sandy, and yet somewhat loamy soil where there were clumps of grass, numerous burning-bushes and an occasional large yucca plant, but no mesquite trees or clusters. Three adult males, collected here, all agree in the possession of a dark brown to grayish ground color which makes the characteristic dorsal dark spots very distinct. A female was light brown in color and the characteristic dorsal dark spots were partly absent and partly very faint. Also, the numerous, small, white spots which cover the back and sides of this subspecies were very much more poorly defined in the female.

In Arizona, 8 miles north of Bernardina, Cochise County, a flat, isolated, grassy area, about 20 feet long and about a fourth as wide, in which two individuals, a male and a female, were found, also sheltered specimens of *Cnemidophorus sexlineatus perplexus* and *Phrynosoma cornutum*. The semi-sandy soil was very reddish and many small rocks were present. As to the lizards, it is interesting to note that the male was dark gray as were the males taken in New Mexico, and that the female was brown or reddish like the female from New Mexico. However, the soil here in Arizona was more reddish, and a comparison of the two females shows that the Arizonan female has much more red in the coloration. In the face of this seemingly definite influence of the environment upon the coloration of the females (a case paralleled by the unsexed examples of *Phrynosoma cornutum* from the two localities), one cannot but wonder why it does not apply to the males as well! The superficial differences between the two sexes of *Holbrookia maculata approximans* are, at least at first sight, greater than that between its female and the female of the ordinary *Holbrookia maculata maculata* from northeastern areas.

Holbrookia texana (Troschel).—A representative of this species was captured at the base of a small mountain 1 mile west of Barillo Camp, or 15 miles east of Balmorhea, Reeves County, in the semi-desert country of western Texas. It was associated here with numerous specimens of *Cnemidophorus sexlineatus perplexus* and *Cnemidophorus tessellatus tessellatus*.

Uma notata Baird.—A single specimen of this distinct and well marked species was found 9 miles east of Yuma, Yuma County, Arizona, in an area characterized by much loose sand and a scattering of bunch grass vegetation. Its field behavior was so similar to that of *Callisaurus ventralis ventralis* that until collected it was presumed to be that form. Both of these lizards occur here in the same habitat.

Sceloporus clarkii Baird and Girard.—One of these spiny swifts was

found under a flat rock in a mountain ledge 14 miles south of Tombstone, Cochise County, Arizona, at 6:30 A.M. on July 20. It was inactive when taken.

Sceloporus elongatus Stejneger.—This was a very abundant species in Uintah County, Utah, where it was found about the extensive rock formations there. Many individuals escaped by hiding in crevices between the stones of their habitat, and usually more were collected where there was some vegetation, as above a stream, than elsewhere. Specimens were taken 4 miles east of Fort Duchesne, 5 miles south of Vernal, 8 miles south of Vernal, and 15 miles southeast of Jensen near the Colorado line.

Sceloporus graciosus graciosus (Baird and Girard).—Representatives of this form were common in Uintah County, Utah, where they were only less abundant than *Sceloporus elongatus* of the same general habitat. *Sceloporus graciosus graciosus* sometimes takes to the bushes as a means of escape, but will also hide in crevices as does *Sceloporus elongatus*. Specimens were obtained 6 miles east of Ft. Duchesne, and 15 miles southeast of Jensen near the Colorado line.

Sceloporus magister Hallowell.—An adult from 15 miles west of Las Cruces, Dona Ana County, New Mexico, occupied a habitat of fine, light brown sand and sought shelter in a mesquite clump.

A second individual was found in an area of sand and sage brush at Hazen, Churchill County, Nevada.

Sceloporus occidentalis occidentalis (Baird and Girard).—These Californian lizards were very abundant in rocky situations, especially in the vicinity of a water supply, such as a mountain spring, although they were by no means wholly confined to such places. One specimen was collected in a city garden where it took refuge under a rock. Specimens when pursued will go into any available crevice, lodging under rocks, culverts, cracks in the earth, leaves, or pieces of wood or tin. We chased one individual up a tree and another into a long tin pipe. These swifts scale rough vertical surfaces with ease and often attempt to escape detection by placing an object, such as the corner of a rock, between themselves and the observer.

Specimens were obtained by Mr. W. H. Burt in Strawberry Canyon, Alameda County; and by ourselves on the Mt. Diablo toll road, Contra Costa County; 11 miles west of Placerville, and 14 miles southeast of Placerville, Eldorado County; 6 miles west of San Rafael, Ross Valley (3 miles northwest of San Rafael), and top of the east peak of Mt. Tamalpais (about 4 miles southwest of San Rafael), Marin County;

above Lake Merced, near Ingleside, San Francisco County; and 2 miles west of Newberry Park, Ventura County.

Sceloporus occidentalis bi-seriatus (Hallowell).—We found this subspecies in brush piles and along rock ledges in San Diego County, California. Specimens were taken at Chollas Heights near San Diego, and 7 miles south of Escondido.

Sceloporus orcutti Stejneger.—One of these crafty lizards was secured from a large rock about 15 feet high 7 miles south of Escondido, San Diego County, California. Many others were observed but all of these found security in deep crevices in the rocks.

Sceloporus undulatus thayerii (Baird and Girard).—A specimen taken at Cambray, Luna County, New Mexico, was found in a sandy, semi-desert area where it took refuge under a yucca plant.

Uta graciosa (Hallowell).—An excellent series of these interesting little tree lizards was taken in Arizona. The usual mode of life is arboreal and only one individual was observed on the ground. While many were seen on the branches of living mesquite trees, only one was found on the branches of a dead tree and it escaped by running into a knothole. Upon being disturbed *Uta graciosa* stretches out at full length and thus flattens its body against the bark of the tree in which it is found so as to escape detection. The dorsal gound color of the lizard usually resembles the color of the bark very closely and on several occasions a specimen in plain sight escaped our attention for some moments.

A marked sexual dimorphism exists, in July at least, and this is much more evident in living specimens than in preserved ones. The living male has much more brilliant blue on the sides of the belly while the female is dull colored. The throat of both sexes is often beautifully tinted with yellow in life, that of the male usually being deeper in shade. The males also have much larger femoral pores than the females.

Specimens were obtained 10 miles southeast of Casa Grande, 2 miles northwest of Casa Grande, 6 miles southeast of Maricopa, 9 miles west of Maricopa, and 10 miles west of Maricopa, Pinal County; and 13 miles west of Maricopa, Maricopa County, Arizona.

Uta levis Stejneger.—This species, which has been called the "Rocky Mountain Tree Uta" by Van Denburgh, was taken by us as it scaled the enormous boulders by the side of the Victory Highway 15 miles southeast of Jensen, Uintah County, in western Utah. There were no trees in the vicinity.

The identity of this form seems somewhat in doubt, but since both Van Denburgh and Tanner have recently admitted it to Utah, our specimens are referred to it.

Uta stansburiana elegans (Yarrow).—This lizard, as we found it in western Texas, southern New Mexico and Arizona, is predominately a sand loving form, and in only one place out of the fifteen at which collections were made was it in a rocky habitat. Individuals are most often found near or within the radius of the great mesquite clumps which develop in the typical part of the range. They dart for nearby holes in the sand when frightened and usually find safety in the numerous tunnels among the roots of the mesquite plant.

In TEXAS, specimens were obtained at Plateau, Culberson County; and 2 miles east of Tornillo, and 1 mile northwest of El Paso, El Paso County. — In NEW MEXICO, 15 miles west of Las Cruces, Dona Ana County; 10 miles east of Deming, Luna County; and Steins, and 12 miles north of Rodeo, Grant County. — In ARIZONA, 5 miles northwest of Casa Grande, and 10 miles northwest of Casa Grande, Pinal County; and 11 miles east of Mohawk, and 7 miles east of Mohawk, Yuma County.

Uta stansburiana hesperis Richardson.—A small number of Utas from southern California are referred to this subspecies, apparently chiefly on geographical grounds. They were all taken from rocky areas, and usually from small boulders. Although most were collected in mountainous districts, several were seen or taken from isolated outcroppings of rock in pastures at much lower levels. In the daytime *Uta stansburiana hesperis* loves to bask in the sun as it perches on the uppermost extremity of a rock. Specimens were collected at Cottonwood, Lyon's Valley, and Bonsall, San Diego County; and 8 miles east of Newberry Park, and Big Tujunga Canyon (11 miles east of San Fernando), Los Angeles County.

Uta stansburiana stansburiana (Baird and Girard).—At Hazen, Churchill County, Nevada, a specimen was secured at 7:30 A.M. in a sandy area which was covered with sage brush. It was sunning itself on the eastern side of a bush.

In Utah, 6 miles east of Ft. Duchesne, Uintah County, examples were found on the ground near an outcropping of rocks. When disturbed several ran to the ledge and concealed themselves by hiding in the crevices between the boulders there.

Phrynosoma blainvilli frontale (Van Denburgh).—A little horned lizard, whose body measures only 30 millimeters in length and whose

tail is 9.8 millimeters long, was obtained among the summit rocks of the shrub-covered Mt. Diablo, Contra Costa County, California, on August 12. A larger example was taken by Mr. Oliver Millard on April 21, 1929, on the trail up Santa Lucia Mountain about 25 miles west of King City, Monterey County, California.

Phrynosoma cornutum (Harlan).—In TEXAS, a fine series of horned lizards was obtained along the roadsides, particularily in rocky and somewhat grassy places. Near Eden, a single individual was found in an extremely barren area near a rock quarry and at times examples were seen on the concrete pavement. Specimens were located 1 mile south of Kileen, Bell County; 2 miles east of Cove, and 1 mile southwest of Cove, Coryell County; and 8 miles south of Eden, Concho County. — In NEW MEXICO an example was found to be rather securely situated at the base of a clump of yucca plants at Cambray, Luna County. Here the spines of the yucca plant were much more formidable than those of the animal. — In ARIZONA, 8 miles north of Bernardina, Cochise County, an individual very closely resembled the red sandy soil upon which it was found.

Phrynosoma douglassii ornatissimum (Girard).—The habitat of one of these "short-horned" horned lizards was found to be the Nevada desert 2 miles north of Fernley, Lyon County, where the sand was coarse and loose and the vegetation was chiefly sage brush.

The occipital horns of this specimen point backwards and not upwards, and if one were to follow the latest keys, it would identify as *Phrynosoma douglassii hernandesi*. Although it seems rather absurd to retain these two forms as distinct from each other on this character alone, others may be found. Accordingly, this specimen is referred to *ornatissimum*, pending our revision of the genus *Phrynosoma*, especially since Van Denburgh, and Stejneger and Barbour, recognize only the latter form from the region.

Phrynosoma modestum Girard.—This distinct species was found living in the basin east of the Barillo Mountains in Reeves County, Texas. Specimens were secured at Barillo Camp (16 miles east of Balmorhea), and 2 miles west of Barillo Camp. Although there is relatively little grass in the region, numerous rocks and shrubs afford protection. One example was found by the roadside. It remained still as we approached, apparently relying solely upon its excellent concealing coloration to escape detection.

Phrynosoma solare Gray.—Between two tracts of sandy soil which were supporting an excellent growth of mesquite trees in southern

Arizona, 12 miles north of Nogales, Santa Cruz County, a specimen was found squatting in the road and relying solely upon its concealing coloration for protection. Another was seen running over an open, barren, sandy section in an auto camp at Tucson, Pima County. It was a male as shown by its large femoral pores and long tail.

Gerrhonotus coeruleus Wiegmann.—Several of these lizards were obtained by overturning the moderately dry mats of grass which were present about the shores of Lake Merced, near Ingleside, San Francisco County, California, at the time of our visit. Another common inhabitant of this same general area proved to be the garter snake, *Thamnophis ordinoides atratus*.

Gerrhonotus scincicauda scincicauda (Skilton).—Two individuals were taken among the dry leaves and grass which had collected in a woodland valley 7 miles west of San Rafael, Marin County, California. When caught they squirmed about a great deal and attempted to bite at every opportunity.

Two of these lizards have been sent to us by Mr. W. H. Burt. They are from Strawberry Canyon, near Berkeley, Alameda County, California, and from Foster's Ranch, Morgan Valley, Contra Costa County, California, respectively.

Leiolopisma laterale (Say).—One of these fine little skinks was captured after a faint rustle betrayed its presence within a heap of dried leaves beneath the oak trees which tower above the steep bank of the Verdigris River 4 miles northeast of Neodesha, Wilson County, Kansas.

Eumeces obsoletus (Baird and Girard).—Three large adults, secured from their secluded retreats beneath the flat rocks of a prairie ledge 6 miles east of Haddam, Washington County, Kansas, on June 26, were only moderately active since it had rained a short time before and the temperature was relatively low.

Snakes

Lichanura roseofusca Cope.—Two specimens of this snake were removed from the road at Dulzura, San Diego County, California. The roadside area was one of brush and rocks.

Heterodon contortrix (Linnaeus).—This hog-nosed snake was obtained from a sandy area in the vicinity of the Little Salt Marsh, Stafford County, Kansas, and Mr. H. H. Schwardt has kindly given us an additional specimen from Argonia, Sumner County, Kansas.

Heterodon nasicus Baird and Girard.—At 8 A.M. on June 23 a medium-sized representative of this species was found lying on a sand bank 2 miles south of Ewing, Holt County, Nebraska, exposed to the full glare of the morning sun. It was dormant and inactive when taken and was easily lifted from the position where it had evidently spent the night. Two small specimens of *Bufo woodhousii*, which were collected near by, were carelessly placed into the collecting bag with the snake and later it was found that they had been devoured.

An example was found dead on the road 10 miles east of O'Neill, Holt County, Nebraska. It was open meadow land on each side of the road. Another specimen was collected in a pasture 4 miles north of Haddam, Washington County, Kansas, in an area of sand and rocks.

Coluber constrictor flaviventris (Say).—The blue-racer is a common snake of the middle west. In OKLAHOMA, it was found 4 miles north of Ochelata, Washington County, and in KANSAS, 3 miles east of Prairie View, Phillips County; and 6 miles east of Haddam, and just west of Washington, Washington County. A dead example was observed in the road 8 miles west of Mankato, Jewell County, Kansas.

Masticophis flagellum flavigularis (Hallowell).—A large example of this subspecies, kindly identified for us by Dr. A. I. Ortenburger, was obtained 2 miles south of San Angelo, Tom Green County, Texas, in a semi-arid area. It was first observed on the road but was finally captured at the top of a mesquite tree about seven feet above the ground.

Masticophis flagellum frenatus (Stejneger).—At 6:30 A.M. on July 22 a small racer of this form was found sunning itself on a sand mound at the base of a desert bush 6 miles southeast of Maricopa, Pinal County, Arizona. Another was obtained in the road 6 miles east of Jacumba, San Diego County, California, in a mountainous, rocky area.

Salvadora grahamiae hexalepis (Cope).—In an area of brush and shrubs one of these snakes was obtained at Indian Springs, San Diego County, California.

Pituophis catenifer catenifer (Blainville).—A specimen found dead on the road 4 miles southeast of Folsom, Sacramento County, California, is apparently intermediate between *Pituophis catenifer catenifer* and *Pituophis catenifer heermanni* both geographically and in coloration. The dorsal spots on the body are 52, and on the tail, 20.

Pituophis catenifer deserticola Stejneger.—This gopher snake was taken 3 miles east of Reno, Washoe County, Nevada, near irrigation

ditches and cultivated fields. Also, 10 miles northeast of Battle Mountain, Lander County, Nevada, near a swamp.

Pituophis catenifer rutilis Van Denburgh.—An adult was stretched out in front of a hole beneath a soapweed bush in the sandy desert 2 miles north of Rodeo, Grant County, New Mexico. When approached it attempted to escape into the hole.

Pituophis sayi (Schlegel).—Bull snakes are very common in the middle west, where they live chiefly in cultivated areas. In KANSAS, specimens were secured 1 mile southwest of Kensington, Smith County; near the Big Salt Marsh, Stafford County; at Belvue, Pottawatomie County; and 6 miles north of Haddam, 5 miles northeast of Haddam, and 2 miles northwest of Haddam, Washington County. — In SOUTH DAKOTA, a small specimen was found at the edge of the road on the right bank of the Missouri River near the Wheeler Bridge, a short distance from Wheeler, in Gregory County. — In COLORADO, a specimen was obtained 12 miles west of Denver, in Jefferson County.

Lampropeltis californiae californiae (Blainville).—Two of these king snakes were found in the road near grass patches at Chollas Heights, San Diego County, California.

Lampropeltis calligaster (Say).—Mr. Howard Shaffer has sent us a specimen of this species that he collected 6 miles north of Haddam, Washington County, Kansas. We observed a partly decayed example on the road 1 mile south of Clifton, Clay County, Kansas.

Lampropeltis triangulum syspila (Cope).—A single representative of this coral king snake was found at Courtland, Republic County, Kansas.

Natrix grahamii (Baird and Girard).—One of these water snakes was found under a stone near the Verdigris River, 4 miles northeast of Neodesha, Wilson County, Kansas.

Natrix sipedon sipedon (Linnaeus).—A large individual, shot near the edge of Nutch's Pond (2 miles east of Haddam), Washington County, Kansas, was found to contain a large transforming tadpole of *Rana catesbeiana*.

Natrix transversa (Hallowell).—An example of this form, taken between Caney, Kansas, and Owen, Oklahoma, 2 miles south of the state line, in Washington County, Oklahoma, was under a flat board near a pond. Another, secured along the Verdigris River, 4 miles northeast of Neodesha, Wilson County, Kansas, was under a flat stone.

Three individuals were found at a partly submerged stone pile near a bridge 2 miles northwest of Toyahvale, Reeves County, Texas.

Here a small stream of clear water flowed past and its pools were filled with fish and frogs and thus, no doubt, it provided food as well as a cover of aquatic vegetation.

Thamnophis megalops (Kennicott).—A specimen, secured 2 miles northwest of Toyahvale, Reeves County, Texas, was lying in the vegetation of a small, running stream with its body partly submerged, but another, 4 miles north of Crittenden, Santa Cruz County, Arizona, was near a shallow, stagnant, roadside pool above which were mesquite trees.

Thamnophis ordinoides ordinoides (Baird and Girard).—Mr. Teunis Vergeer has given us several specimens of this form that were collected by Mr. J. Vergeer at Portland, Multnomah County, Oregon.

Thamnophis ordinoides atratus (Kennicott).—We found this garter snake along the small Islais Creek, below Mission Bridge, in San Francisco, San Francisco County, California, where it was associated with large numbers of the frog, *Hyla regilla.* These snakes were particularly abundant at Lake Merced, near Ingleside ,in the same county, where they occurred in the grass and sedges at, and above, the edge of the water.

Thamnophis ordinoides elegans (Baird and Girard).—Two Californian representatives of this subspecies were found dead on the highway in the vicinity of running water. These were taken at the north end of the Antioch Bridge on the Victory Highway, in Solano County, and at Truckee, Nevada County, respectively.

Thamnophis ordinoides vagrans (Baird and Girard).—Near a clear mountain stream 4 miles east of Fort Duchesne, Uintah County, Utah, and by the side of a dirty roadside pool at Bear River, Routt County, Colorado, representatives of this form were collected. Others were taken in Routt County, 5 miles northwest of Steamboat Springs, and 10 miles south of Steamboat Springs, in the latter place by the side of mountain spring at the foot of Rabbit Ear Pass.

Thamnophis radix radix (Baird and Girard).—On April 30, 1927, a pair of these garter snakes were taken from a hole in the vicinity of the Little Salt Marsh, Stafford County, Kansas. They were entwined about each other and were probably carrying on mating activities, although actual copulation was not observed. Mr. H. H. Schwardt has given us a specimen from Silvia, Rice County, Kansas, and we took one 3 miles east of Rexford, in Thomas County.

In Colorado, one was found along a small stream 3 miles east of Denver, Denver County.

Thamnophis sauritus proximus (Say).—An adult was found under a rock in a prairie ledge above a permanent streamlet 6 miles east of Haddam, Washington County, Kansas. Another, secured at Mertzon, Irion County, Texas, was in a semi-marshy pool by the side of a slow-flowing creek.

Thamnophis sirtalis sirtalis (Linnaeus).—One of these snakes was found near a meadow 5 miles southeast of Dyersville, Dubuque County, Iowa.

Thamnophis sirtalis parietalis (Say).—All of our specimens of the red-sided garter snake were collected in Kansas. We found them at the edge of Nutch's Pond (2 miles east of Haddam), and on the bank of Mill Creek, just north of Morrowville, in Washington County. In the latter locality two young were secured on September 2, and these, we presume, were born but a short time before. An adult was crawling along the muddy bank of the Verdigris River, 4 miles northeast of Neodesha, Wilson County, on July 8.

Tantilla gracilis (Baird and Girard).—Two sand snakes were on a flat, elevated, grassy plain under rocks in the vicinity of Little Bear Mound at Neodesha, Wilson County, Kansas. They were in the dampest situations possible and specimens were not found under rocks that were completely dry beneath.

Crotalus confluentus confluentus (Say).—This rattlesnake was found near an open prairie, chiefly of buffalo grass, 3 miles southeast of Buick, Elbert County, Colorado. Another was taken in a similar habitat 9 miles west of Limon in the same county.

Crotalus exsul (Garman).—An adult of this form was found at Dulzura, San Diego County, California, resting on a pile of rocks in the shade of an irrigation wall.

Sistrurus catenatus catenatus (Rafinesque).—One of these rattlesnakes was located in a grassy pasture 5 miles northeast of Haddam, Washington County, Kansas.

Turtles

Chelydra serpentina (Linnaeus).—This species is ordinarily confined to the permanent ponds and streams, but after rains individuals may be found long distances from water. Thus, one of our specimens was taken near farm buildings and another on the main street of a town. Both were secured after a rain and both had traveled, no doubt, from the nearest streams.

In Kansas, specimens were found 6 miles east of Haddam, Washington County, and Mr. Richard E. Nelson has given us an example collected 2 miles south of Blue Rapids, Marshall County.

In addition we have specimens taken at Bristow, Boyd County, Nebraska, and one presented to us by Miss Bertha L. Danheim from La Salle, La Salle County, Illinois.

Pseudemys elegans (Wied).—A large example of this form was obtained on the bank of the Verdigris River 4 miles southeast of Neodesha, Wilson County, Kansas.

Terrapene ornata (Agassiz).—These land turtles are very common in the middle west, particularly in pastures where they find shelter in shallow holes or burrows. In NEBRASKA, specimens were collected 2 miles northeast of Bristow, Boyd County. — In KANSAS, 3 miles west of Lawrence, Douglas County; and 6 miles east of Haddam, and 6 miles north of Haddam, Washington County.—In OKLAHOMA, 7 miles north of Ochelata, Washington County.

Chrysemys bellii bellii (Gray).—In Nebraska, our specimens were obtained in the shallow, sand-bottomed Ponca Creek just south of Bristow, on the road just west of Bristow (after a rain), and in shallow ponds 5 miles north of Bristow, all in Boyd County. An example secured 2 miles east of Flagler, Kit Carson County, Colorado, was carried into Kansas and while there it escaped from us.

ZOOLOGY.—*A new species of* Centrolophus *from Monterey Bay, California.*[1] KENNETH L. HOBBS, Linden, Md. (Communicated by E. A. GOLDMAN.)

While collecting in the harbor of Monterey during early August, 1929, I found three specimens of Rudder Fish living commensally within the gastrovascular cavity of the large jelly-fish *Phacellophora ambigua* (Haeckel). This medusa was quite abundant in the harbor at the time, having collected in the coves and among the pilings of docks. Specimens of the parasitic amphipod *Hyperia medusarum* (Müller) were also found in the canals of the medusae containing the fish. This, I believe, is the first time that this genus of fish has been recorded from the coast of California. Other members of the genus being found in Australia, *C. maoricus* (Ogilby), and two in the North Atlantic, *C. brittanicus* (Gthr.) and *C. niger* (Gmelin), the latter also occuring in the Mediterranean.

[1] Received October 20, 1929.

Centrolophus californicus sp. nov.

D. 40–43 A. 28–30 P. 19 V. 1–5 Scales 120–11–1–22

Depth of body into length 3 times, length of head 3.2 times. Body elongate and compressed. Diameter of eye contained in length of head 3.65–3.75 times. Maxillary under preorbital for entire length but not hidden. Palatine teeth none. Maxillary teeth in a single series. Interorbital width into head length 2.8–3 times. Preoperculum without spines. Gill rakers elongate. Snout into head length 4.5.

Dorsal fin rays 40–43 increasing in length and becoming rounded posteriorly. Spines of the dorsal indistinct. Anal fin rays 28–30 with an outline similar to the dorsal and likewise rounded most posteriorly. Caudal fin slightly forked with rounded lobes. Pectoral 19, ovate. Ventral 1–5.

Scale count from the upper anterior opening of the gill chamber to the base of the caudal fin 120. 11 or 12 scales above the lateral line, 21 to 25 below.

Lateral line curved anteriorly becoming straight at a point midway between tip of snout and tip of caudal fin. Each scale in the lateral line pierced by a pore. Specimens, probably young, measuring 81–40 mm.

COLOR: Silvery gray above and pale below. Fins blackish to gray.

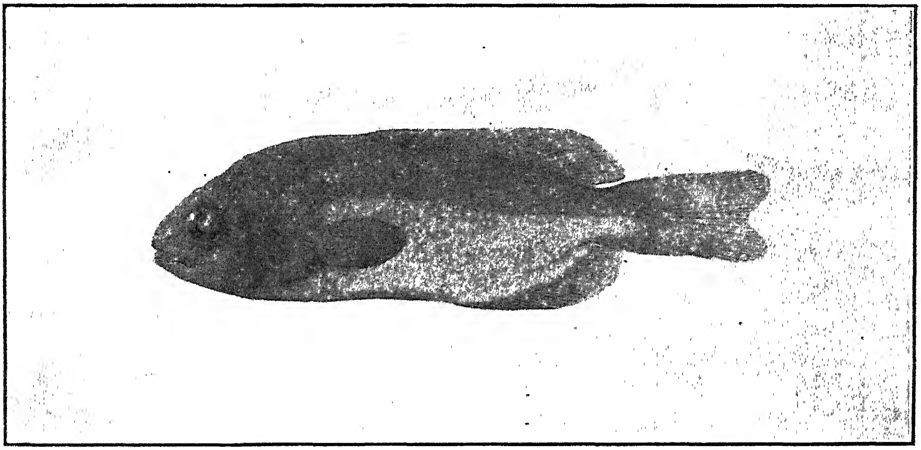

FIG. 1. *Centrolophus californicus* sp. nov.

REMARKS: Specimens removed from the medusa lived successfully for several days in a pint jar with running water. At the end of that time the larger animals developed cannibalistic tendencies toward the smaller individual. This feature seemed to show that the pint jar made a good substitute for the Scyphozoan. The body of the animals was extremely delicate and soft, necessitating extreme care in preserving them.

TYPE: In U. S. National Museum, Washington D. C. Cat No. 89398. Figure 1.

Summary of the species of Centrolophus

	brittanicus[a]	niger	maoricus	californicus
Depth of body in total length (standard)	4	4	4	3
Length of head in total length (standard)		4⅓–5	4½	3.2
Eye into head length		4–4¾	4.1	3¾
Interorbital into head length		3½		2.8–3
Dorsal fin rays	45	37–41	38	40–43
Anal fin rays	30	111–20–22	25	28–30
Caudal		forked	deep emarginate	forked
Scales		185–205		120
Length of specimens	520 mm.	480 mm.		80 mm.
Color		Brown	Brown	Gray

[a] *Centrolophus brittanicus* is known from only one stuffed specimen, so that accurate measurements are impossible.

SCIENTIFIC NOTES AND NEWS

Professor Asaph Hall, for many years astronomer at the U. S. Naval Observatory, has recently retired. He is making his home at Upper Darby, Pennsylvania, and continuing his scientific work.

Dr. W. V. Balduf, of the University of Illinois, is spending a sabbatical year in Washington and has made arrangements to study Hymenoptera in the National Museum during a considerable part of the time.

M. Jacques Berlioz, ornithologist at the Museum d'Histoire Naturelle, Paris, recently spent a day in the Division of Birds, U. S. National Museum. M. Berlioz had been in this country and Canada for about three months, visiting museums and National Parks.

Obituary

Dr. R. Wilfred Balcom, Principal Chemist in charge of the Food Control Division of the Food, Drug, and Insecticide Administration, U. S. Department of Agriculture, and a member of the Academy, died October 17, 1929. He was born in Nova Scotia in 1877, studied at the Massachusetts Institute of Technology and at German Universities, receiving the degree of Ph.D. from Heidelberg in 1905. He taught for several years at the Massachusetts Institute of Technology and the University of Michigan, and later entered the Bureau of Chemistry of the Department of Agriculture, being transferred, upon the creation of the Food, Drug, and Insecticide Administration, to the position he held at the time of his death. He specialized in problems of food analysis and food control.

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GEOLOGY.—*On some recent excursions into Pleistocene geology and paleontology.*[1] OLIVER P. HAY, Washington, D. C.

Within recent months there have appeared certain articles on the Pleistocene which the present writer proposes to review.

One of these papers has as its author Mr. J. E. Eaton, consulting geologist, Los Angeles, California,[2] and is entitled *Divisions and duration of the Pleistocene in southern California.* This writer tells us that the Pleistocene record in the region mentioned indicates a duration of the epoch in excess of 1,000,000 years; also that the terms Pleistocene and Glacial are not synonymous.

As regards the duration of the epoch certain adherents of the prevai ing theory have already invoked a considerably longer period.

As for the relation of the Pleistocene and the Glacial epochs opinions differ. Most European geologists include in the Pleistocene only the last two glacial stages, relegating the first two to the Pliocene. American authors usually hold that the epochs are one and the same in extent. Eaton on the other hand intercalates in the Pleistocene a time, the Sierran, which precedes the Glacial and is much longer. It is not my purpose to argue about the chronological position of the Sierran. It is noted, however, that Chamberlin and Salisbury escape Eaton's conclusions by flatly assigning the Sierran to the Pliocene, and apparently Schuchert does the same.

Eaton's views on the time and manner of ushering in the Pleistocene are of more interest to me. California appears to have been from remote times geologically active. From the close of the Jurassic the earth's crust was split, broken into great blocks and the fragments

[1] Received November 14, 1929.

[2] Bull. Am. Assoc. Petr. Geol. **12**: 111–141. 1928.

were tilted. From the middle of the Eocene to the early Pleistocene marine deposits were laid down without interruption to a thickness of more than 30,000 feet. Then, as if in anticipation of the great psychic forces that were to dominate that region in the distant future, preparations were early initiated for the new era. The transition from the Pliocene to the Pleistocene was accomplished quickly. The change in the marine fauna in the basal 100 feet of the transition zone was greater than that effected in 6,000 feet of the Pliocene strata. The cause of this critical change is set forth as being a hard but sharp oscillation; also it is described as a tremendous shock or shudder, which seemed however to produce little other immediate consequences. The biological result, however, was to metamorphose the Pliocene fauna containing 36.3 per cent of extinct species into a Pleistocene assemblage that included from 1.8 per cent to 7.4 per cent only of extinct forms.

It is commonly supposed that geological ages, periods, and epochs begin and end all over the world at the same time, but there appear to be exceptions. The percentage of extinct species noted above is only somewhat less than that of the Plaisancian of Italy. It follows then that the Pleistocene of California began at a time when the rest of the world was entering into about the middle of the Pliocene.

The Glacial epoch is placed by Eaton near the end of the Pleistocene. He devotes a few paragraphs to the vertebrate fossils found at La Brea near Los Angeles. He regards the time of their existence as being in the upper, and probably uppermost, Pleistocene. He quotes my good friend Dr. Chester Stock as informing him that all those species should be placed somewhere in the last half rather than in the first half of the Pleistocene. The present writer would be glad to have these scientific gentlemen inform him what kinds of animals lived during the first half of the epoch and where their remains have been discovered and where described.

Recently Dr. J. W. Gidley published[3] a paper with the heading *Ancient man in Florida: further investigations.* Dr. Gidley has had fine opportunities for the study of the geology and paleontology of the Pleistocene beds along the coasts of Florida and naturally the present writer has been interested in learning of his discoveries and conclusions. A considerable part of the paper cited deals with the geology. He finds the structure of the beds to be essentially as described by Sellards, but holds different views about their origin. Stratum No. 2 is now named

[3] Bull. Geol. Soc. Am. **40**: 491–501. 1929.

the Melbourne bone bed. Gidley's view is that it was formed by drifting sea-sands which slowly covered up and preserved the bones and teeth of the numerous vertebrates. It is very questionable that such abundant remains of vertebrates would endure the effects of exposure to the weather while lying on the surface of dry sand or buried in it. The presence of water and carbonate of lime appears to be necessary for fossilization of bones. Gidley finds that the numerous fossils found in bed No. 3 were in reality lying on the surface of No. 2. The supposition is that this surface was for a long time exposed to the open air and we are asked to believe that the bones of animals accumulated on it during a long period. It is impossible to believe that the bones of animals, especially of small ones, would endure for a long time the disintegrating influence of the weather, the attacks of insects, and the trampling of living animals. Dr. C. W. Cooke's view that the sand was carried into shallow grassy ponds seems more reasonable.

Dr. Gidley holds that the muck bed, No. 3, was laid down in a swamp which excluded land animals, and that for this reason there are in it no fossils. However, even if we should admit that the deposit was formed, at least in part, after the close of the Wisconsin stage, there were still in existence elephants, mastodons, bears, giant beavers, otter, peccaries, alligators, and tortoises, all of which delighted in such swamps. It seems therefore odd that none of them left their bones in that deposit, resting as it does on a good solid bottom. There must be some other reason for the lack of fossils.

Of the greatest interest is Gidley's conclusion regarding the age of the Melbourne bed and its fossils. He insists that when the fossils have been critically examined they prove to be of different species from those found elsewhere, especially the horses, the camels, and proboscideans. He does not tell us who has made these critical studies and certainly he has not made them himself, having published little more than preliminary lists, mostly devoid of specific determinations. As for the horses only three species are known from the state and all of them have been found outside of it and two of them far away. The proboscideans usually found there are recognized as having inhabited the greater part of the continent. The camels are few and closely related to outside species. It goes without needless repetition that Florida possessed and now possesses a few species of mammals not known from other regions, as these other regions each had their peculiar species.

Dr. Gidley appears to attach high importance to *Elephas columbi*, said to be a late Pleistocene species. Such it is, but it is also a species

of the middle and of the early Pleistocene and a common fossil almost everywhere.

Whatever the Pleistocene species found in Florida may be, they were derived in part from the stock native to North America, in part from invaders from South America, and in part from immigrants from Asia; and they had changed exceedingly little from their ancestors. If modified at all in Florida they had become more adapted to a tropical climate and were more susceptible to adverse changes in their environment. It would be beneficial for those who believe that a glacial stage was not much of a storm to study the glacial map published by Dr. Schuchert in Pirsson and Schuchert's *Text-Book of Geology*, on page 945. This map shows that at some time or times, during the Pleistocene, glaciers existed throughout the length of the Andean range, even on the equator; likewise in Africa on the equator; also in the Himalaya Mountains. And these glaciers extended far beyond the limits of their modern representatives. That map clearly indicates that during the Pleistocene there were times when the temperature of the whole world was lowered. This view is expressed by both Chamberlin and Schuchert in their geologic text-books. When the great glaciers covered large parts of North America the mammals of the northern regions could move south and find an endurable climate. Those living in Florida had no such resource and had to suffer the consequences.

Dr. Gidley's paper furnishes us a comprehensive scheme of the times and methods of mammalian distribution throughout North America. It starts with a colony of animals dwelling in Mexico during the first glacial stage. On the decline of this stage migrants made their way north and took possession of the region west of the Mississippi River. On the advent of the second glacial stage the animals retired southward. When this cold stage gave way there was another northward migration; but on reaching their former pastures they found that these had been made arid by the action of the ice. The animals were therefore compelled to move across the Mississippi into Pennsylvania, Maryland, and the District of Columbia, to obtain food and water; later they migrated to Florida.

On May 10, 1927, Dr. Gidley gave a newspaper writer an interview on the results,—geological, paleontological, and anthropological—of his investigations in Florida. This was nearly three months after his paper had been delivered to the Bulletin of the Geological Society of America. During this time he had matured his ideas and was enabled to make definite statements regarding the dates and courses of

the wandering herds. During the first glacial stage, the Nebraskan, mastodons, elephants, camels and other species inhabited Mexico. During the first interglacial stage, the Aftonian, the herds moved north. As a matter of fact, there are found in Iowa, in deposits of this stage, abundant fossils of these mammals. During the second glacial time, the Kansan, they returned again to the south. On the retirement of the Kansan ice, in the second, or Yarmouth, interglacial stage, a migration was made northward, but the region had become arid and the journey was made across the Mississippi. Then came on the last glacial stage, we are told, and the animals were driven into Florida where, after some thousands of years they became extinct. This hypothesis merits some attention.

It is extremely doubtful that evidence can be presented that any species of elephant existed in Mexico during the first glacial stage. While it is certain that the region west of the Mississippi was supplied with mastodons, elephants, camels, and horses, we are not told whether our eastern states possessed any vertebrates during the first and second glacial stages and the first interglacial. It would also be interesting to listen to the arguments presented to show that the prevalence of ice tends to render a region arid instead of swampy.

Among the important extinct mammals found in the Melbourne beds in Florida are *Elephas imperator*, two or more species of glyptodons, a gigantic armadillo, and a megatherium. Now, according to Dr. Gidley's history, these animals must have been a part of the immigrants into our eastern region. Several large collections of fossil vertebrates, which may well have lived during the Yarmouth stage or were at least descendents of those which lived then, have been made in Maryland, Virginia and Pennsylvania, but nobody has reported the discovery of a scrap of a skeleton of any one of the important species mentioned above as found in the Melbourne beds.

It is true that during the Yarmouth stage few vertebrates appear to have existed in Iowa, but is this lack of fossils due to aridity of climate? It is very probably due to the fact that Yarmouth deposits are buried under later drift beds.

Now a few words about the alleged arid climate of Iowa during the Yarmouth. In Monograph 32 of the U. S. Geological Survey, Dr. Frank Leverett writes thus about the Yarmouth deposits in the southeastern corner of the state: "The Illinois till in Lee County, as also in counties to the north, is separated from the underlying Kansan till sheet by a weathered zone accompanied by beds of black muck and

peaty material" (p. 7.) On his page 42, he presented a geological section of the Yarmouth, part of which is as follows:

Peat bed with twigs and bones.....15 feet
Clay containing wood.............12 feet

As further evidence of abundant water during the Yarmouth, Leverett found that the top of the Kansan drift has been eached of its lime to a depth of from four to six feet.

Recently Dr. George F. Kay[4] wrote that the Yarmouth is widely present in northeastern Iowa, overlain by Iowan drift, and in southeastern Iowa, overlain by Illinoian drift. In many exposures there is found on the upper surface of the Kansan drift an old soil or "forest bed." From these reports the conclusion is easily drawn that during that long geological stage there was an abundance of rain and of vegetation and that there were other mammals there besides rabbits and skunks.

Dr. Gidley's hypothesis greatly simplifies the history of the Pleistocene, inasmuch as it eliminates two glacial stages, the Iowan and the Wisconsin, and two interglacial, the Peorian and the Sangamon. This solution, if confirmed, will indeed "tend to push the Pleistocene further toward the present." In case Dr. Gidley can induce American geologists to adopt the European method of beginning the Pleistocene with the third glacial stage, the epoch will be brought to a satisfactory state of insignificance.

Dr. Gidley and others who insist that the fauna present in the Pleistocene beds in Florida lived until, or into, or near, the Recent epoch recognize the necessity of proposing a cause for the sudden and enormous change in the genera and species. They are, therefore, now asserting that it was coincident with the arrival of the Indians in America. When Columbus reached America these Indians had warred on the game animals for at least a few thousand years without diminishing their numbers. The forests and prairies, the mountains and the rivers, swarmed with mammals, birds and fishes. It is surprising then that the Pleistocene inhabitants, armed with feeble weapons, should be thought capable of destroying the herds of elephants, mastodons, great bisons, the horses, and the numerous tigers, wolves, and sloths that inhabited North America.

Dr. Gidley has twice published the statement that the great proboscideans, elephants and mastodons, existed in Florida long after they

[4] Bull. Geol. Soc. Am. 40: 86. 1929.

had become extinct in the northern states. No evidences to sustain this view have been produced and none at present can be offered, except that Florida possesses a climate more favorable for animal life. Is there any truth in this notion?

The writer has collected lists of the mammals that existed in early historic days in three states, Florida, Illinois and the mountain region of Colorado. Florida possesses 58,685 square miles of territory, Illinois 56,000, the mountainous region of Colorado approximately 65,000. From reliable authorities it is learned that Florida harbors 65 species and subspecies, Illinois 60 species and subspecies, and the mountain region of Colorado 110 forms. If we proportion the species in each region to areas of the same size, that of Illinois, 56,000 square miles, we shall have for Illinois 60 species and subspecies, for Florida 63, and for Colorado 94.

We see therefore that in number of mammalian forms Florida stands only a little ahead of Illinois and far behind the mountain region of Colorado. Nor is it probable that any one will contend that the mammals of Florida are superior in size, structure, or intelligence, to those of the more northern regions.

The fossil mammals of the Villafranchian group in Italy are of about the same age as those of our Aftonian stage. They include the genera *Felis, Machairodus, Hyaena, Bos, Cervus, Tapirus, Equus,* and two species of primitive elephants. Italy must have always had a milder climate than the lands to the north. Why should not those who argue for a late age of the mammals of the Melbourne beds insist on the same age for the deposits of Val d'Arno? The motive furnished by human remains is apparently wanting.

PALEONTOLOGY.—*New species of fossil decapod crustaceans from California.*[1] MARY J. RATHBUN, U. S. National Museum

Through Leo G. Hertlein, Department of Paleontology, California Academy of Sciences, fossil specimens of a crab and a shrimp new to science were sent to the U. S. National Museum for identification and description.

Nephrops shastensis, sp. nov.

TYPE: From 2 miles north of Bella Vista, Shasta County, California; Chico, upper Cretaceous; G. D. Hanna and F. M. Anderson collectors, April, 1928. Body and one cheliped exposed (see fig. 1, page 471). Specimen in California Academy of Sciences. The fossil occurred in a bed of earthy shale

[1] Received November 7, 1929.

about 300 feet thick, dipping south 10°. This overlies a zone of sandstone 520 feet thick with same dip and strike and this in turn lies on Triassic slates striking N.W.—S.W. with a dip S.E. of 75°–85°.

MEASUREMENTS: Length of carapace to end of rostrum 33.5, length of rostrum from tip to posterior curve of orbit 9, greatest height of carapace 15, approximate length of cheliped 72, length of chela 46, greatest width of chela, across fingers 9.6, length of dactylus along inner margin 24, width of pleuron of second abdominal segment 8 mm.

DESCRIPTION: Carapace: Upper margin slightly arcuate in front of cervical suture, straight behind the suture. Surface marked with numerous very short, fine raised lines having the appearance of granules. Cervical suture slightly oblique, nearly straight, very broad above the middle of the carapace, below the middle gradually diminishing, and ending at about the lower fourth of the carapace. The hepatic groove so far as it is visible occupies the middle third of the vertical distance of the carapace; it is subparallel to the cervical groove and is deeper; at its lower end it forks into two short equal branches; the anterior branch is prolonged in a shallow furrow which curves into a longitudinal direction toward the anterior angle of the carapace. Between the cervical and hepatic grooves there is a low longitudinal elevation, and one similar but higher in the same line in front of the hepatic groove; this last named swelling is bounded anteriorly by a shallow groove. A tubercle, which may have been a spine, lies a little behind and above the deepest part of the orbit. On the upper margin of the rostrum there are indications of three small spines, one at the base, one near the tip, and the other half way between.

Portions of the first four abdominal somites remain. The surface where present is smooth and punctate. The pleuron of the second somite is longer, in the direction of the axis of the body, than it is deep; it is suboval, obtusely angled at the lowest point and its surface is more or less concave. The tip of the third pleuron projects below the second and is rectangular, the angle pointing downward.

The surface of merus, carpus and palm of cheliped is rough with short transverse rugae; merus narrow, increasing in width distally; the carpus appears short and has a large spine on its upper margin. Chela very long; palm increasing in width from the proximal to the distal end; exposed surface gently rounded, without carina; fingers about as long as palm, the fixed finger narrower than the dactyl and overreaching it a little; both fingers are irregularly dentate, the dactyl has a lobe at its distal two-fifths whereas the fixed finger has a smaller lobe on either side of it. The articulation of the dactylus is concealed.

Persephona invalida, sp. nov.

TYPE: From San Diego, California; Pliocene. Carapace only. Specimen in California Academy of Sciences. Orig. No. 1413. A fragment of a smaller specimen bears the same number.

MEASUREMENTS: Extreme length of carapace 39.4, approximate width 36, height 17.5 mm.

DESCRIPTION: Fronto-orbital region horizontal and slightly advanced beyond the spherical portion of the carapace. Cardiac and intestinal regions delimited laterally, the intestinal region deeply so. The entire surface of the carapace is thickly covered with coarse conical granules varying in size,

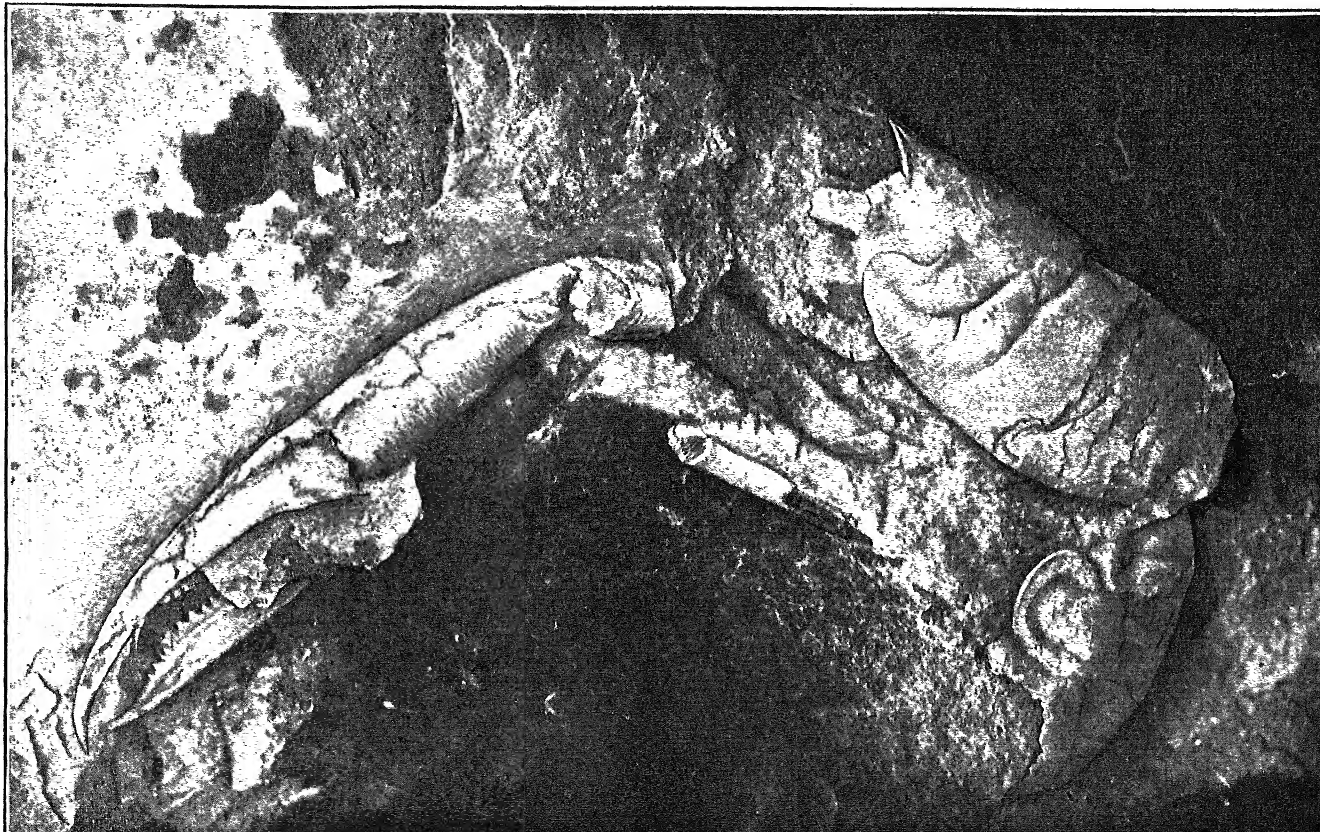

Fig. 1. *Nephrops shastensis*, holotype, side view, × 2.

the spaces between the larger ones filled with smaller ones; on the anterior quarter of the carapace the granules become progressively smaller and more crowded. The frontal teeth are broad, blunt and hood-shaped and more advanced than the outer tooth of the orbit; fronto-orbital margin granulate; two closed fissures in the upper orbit, separated by a broad, shallow lobe. The outer of these fissures is continued backward in a broad, shallow depression which partially defines the hepatic region. Still further back on the right side may be seen the marginal hepatic angle. Posterior margin of carapace incomplete and obscure; no intestinal median spine; there may be a spine at the outer end of the posterior margin but it cannot be determined with certainty.

In shape and general appearance this carapace most resembles the Recent *P. punctata* (Linnaeus)[2] from the southeastern coast of North America.

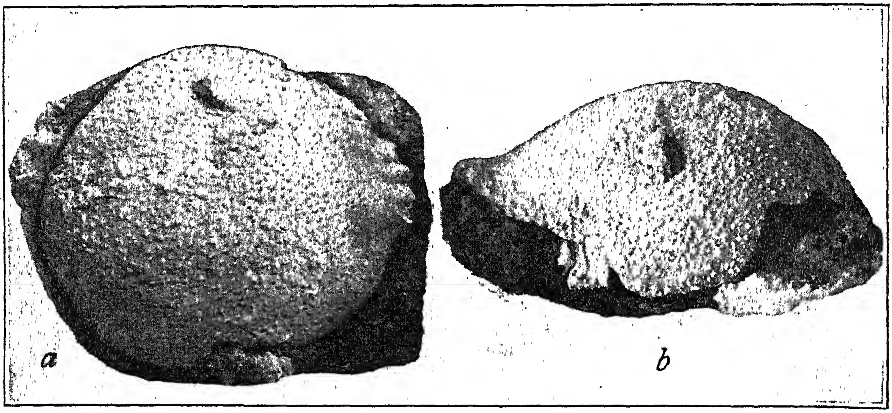

Fig. 2. *Persephona invalida*, holotype, carapace, × about 1¼. *a*. Dorsal view. *b*. Left profile.

BOTANY.—*On the names of certain species of* Deguelia (Derris).[1] S. F. Blake, Bureau of Plant Industry.

In recent years a number of species of the leguminous genus usually known as *Derris* have attracted attention as insecticides. The nomenclature of the genus as well as of some of its species is considerably involved. The present paper is the result of an attempt to determine what names certain species of the genus, discussed in a projected publication of the Bureau of Chemistry of the U. S. Department of Agriculture, should bear under the American Code of Botanical Nomenclature.

[2] *Cancer punctatus* Linnaeus. Syst. Nat., ed. 10. 1: 630. 1758. (In part.)

[1] Received November 19, 1929.

Loureiro's name *Derris*, which has been generally used for the genus in both botanical and chemical literature, is antedated by several other generic names. Four of these can be disposed of readily. *Pterocarpus* L. 1747 (not L. 1763) was taken up by Kuntze,[2] but is of course removed from consideration under modern codes of nomenclature because of its date. *Salken* Adans.[3] and *Solori* Adans.,[4] the pertinence of which to the genus under discussion has been established by Prain,[5] are not available under the American Rules because not associable with a binomially named species. Although available under the International Rules, they are removed from consideration by the retention of *Derris* Lour. as a nomen conservandum. *Cylizoma* Neck.,[6] of even date with *Derris*, is a mere renaming of *Deguelia* Aubl.

Deguelia Aubl.,[7] the earliest available name for the genus under the American Code and the one which must be used by those who follow it, was based on a single species, *Deguelia scandens*. Aublet's material was a mixture, the fruit figured and described[8] being that of *Muellera moniliformis* L. f. His description, excluding the character of the fruit, is based on the plant afterwards named *Derris guianensis* by Bentham, and his generic name has long been regarded as equivalent to *Derris*.

Derris Lour.,[9] as originally published, included two species, *D. pinnata* and *D. trifoliata*. Both species have been variously identified by different authors. Merrill,[10] apparently the last author to discuss their status critically, is satisfied that *D. pinnata* is identical with *Dalbergia tamarindifolia* Roxb., and *D. trifoliata* with *Derris uliginosa* (Roxb.) Benth., and his statement of the case seems to dispose of the doubts which had been raised by Prain[11] in 1897 and 1904.

Study of Loureiro's descriptions indicates that the apparently universal action of botanists in restricting his name to the "Derris" component is not justified. His generic description runs as follows:

[2] Rev. Gen. Pl. **1**: 202. 1891.

[3] Fam. Pl. **2**: 322, 600. 1763.

[4] Fam. Pl. **2**: 327, 606. 1763.

[5] Ann. Bot. Gard. Calcutta **10**: 10. 1904.

[6] Elem. Bot. **3**: 33. 1790.

[7] Hist. Pl. Guian. **2**: 750. *pl. 300*. 1775.

[8] See Bentham, Journ. Linn. Soc. Bot. **4**: Suppl. 106. 1860.

[9] "Fl. Cochinch. 432. 1790;" ed. 2. 525. 1793.

[10] Philipp. Journ. Sci. ser. C. Bot. **5**: 96, 105–6. 1910.

[11] Journ. Asiat. Soc. Bengal **66**: 458. 1897 (*Derris trifoliata*); Ann. Bot. Gard. Calcutta **10**: 48, 108. 1904 (*Derris pinnata*).

†GENUS X. DERRIS.

Descriptio naturalis.

Cal. Perianthium tubulosum, coloratum, margine 5-crenato, erecto.

Cor. Petala 4, papilonacea, longitudine subaequalia: vexillo ovato: alis oblongis: carina lunata: omnibus basi falcatis, unguibus filiformibus insistentibus.

Stam. Filamenta 10, omnia connata in vaginam, aequalia, brevia. Antherae didymae lobis rotundis.

Pist. Germen oblongum, compressum. Stylus aequalis staminibus. Stigma simplex.

Peric. Legumen oblongum, obtusum, compressissimum, membranaceum, laeve, monospermum.

Sem. oblongum, planum.

Nom. (Δέρρις), membrana) a legumine membranaceo.

Char. gener. *Cal.* 5-crenatus, coloratus. *Petala* unguibus filiformibus. *Legum.* oblongum, membranaceum.

Every feature in this description which is distinctive of either of the two included modern genera (*Derris* of authors, as represented by *D. uliginosa*, and *Dalbergia*, as represented by *D. tamarindifolia*) applies to the *Dalbergia* component alone. The calyx in the *Dalbergia* is distinctly 5-toothed, that of *Derris uliginosa* much less strongly so (by Prain described as subtruncate; Loureiro described that of his *Derris trifoliata*, in opposition to the generic character, as "leviter 4-dentato"). In both species the keel petals are united toward the tip (Loureiro gave the petals as "4"), but in the *Dalbergia* their claws are relatively much longer and more slender, and in much better agreement with Loureiro's "filiformibus." In both the stamens are monadelphous; but the description of the anthers as "didymae lobis rotundis" applies exactly to the *Dalbergia*, not at all well to the *Derris*. The character of the fruit, from which Loureiro derived his generic name, fits the *Dalbergia*, not the *Derris*. Loureiro described the pod as 1-seeded both in the generic description and in the description of *D. pinnata;* the pod of *D. trifoliata*, of which he had not seen mature fruit, he described as 2-3-seeded, again attributing to this species a character not in agreement with his generic description. In *Dalbergia tamarindifolia* the seed is narrowly oblong, more than four times as long as wide; in *Derris uliginosa* it is reniform-orbicular and practically as broad as long. In view of all these points of agreement of Loureiro's generic description with the *Dalbergia* component, and its corresponding disagreement with the "*Derris*" component, it would seem clear that the name *Derris* Lour. should be typified by his first species, *D. pinnata*, which is *Dalbergia pinnata* (Lour.) Prain (*D. tamarindifolia* Roxb.), and should consequently be remanded to the synonymy of *Dalbergia* L. f. (1781), the oldest name for which is *Amerimnon* P. Br. (1756). The question

of the typification of *Derris* is, however, merely an academic one, since the name has been conserved under the Vienna Rules in the sense of *Deguelia* Aubl., and since the latter name must be adopted under the American Code.

The following species, discussed in a projected publication of the Bureau of Chemistry and Soils dealing with *Derris* as an insecticide, require transfer to *Deguelia:*

Deguelia benthamii (Thwaites) Blake.
Brachypterum benthamii Thwaites, Enum. Pl. Zeyl. 93. 1859.
Derris paniculata Benth. Journ. Linn. Soc. Bot. **4**: Suppl. 105. 1860.
Derris benthamii Thwaites, Enum. Pl. Zeyl. 413. 1864.
Deguelia paniculata Taub. Bot. Centralbl. **47**: 388. 1891.

Deguelia heptaphylla (L.) Blake.
Sophora heptaphylla L. Sp. Pl. 373. 1753.
Derris sinuata Benth.; Thwaites, Enum. Pl. Zeyl. 93. 1859.
Derris heptaphylla Merr. Interpr. Rumph. Herb. Amboin. 273. 1917.

Deguelia koolgibberah (F. M. Bailey) Blake.
Derris koolgibberah F. M. Bailey, Rep. Exp. Bellenden-Ker 38. 1889.
The uncouth specific name is, according to its author, "the aboriginal name for the Mulgrave River," where the plant was collected.

Deguelia malaccensis (Benth.) Blake.
Derris cuneifolia β. malaccensis Benth. Journ. Linn. Soc. Bot. **4**: Suppl. 112. 1860.
Derris malaccensis Prain in King, Journ. Asiat. Soc. Bengal **66**: 107. 1897.

Deguelia oligosperma (K. Schum. & Lauterb.) Blake.
Derris oligosperma K. Schum. & Lauterb. Fl. Deutsch. Schutzengeb. Südsee 361. 1901.

Deguelia philippinensis (Merr.) Blake.
Derris multiflora β.? longifolia Benth. Journ. Linn. Soc. Bot. **4**: Suppl. 108. 1860. Not *Derris longifolia* Benth. 1860.
Derris philippinensis Merr. Philipp. Journ. Sci. ser. C. Bot. **5**: 104. 1910.

Deguelia polyantha (Perkins) Blake.
Derris polyantha Perkins, Fragm. Fl. Philipp. 83. 1904.

NOTICE OF PROPOSED REVISION OF THE BY-LAWS OF THE WASHINGTON ACADEMY OF SCIENCES

At a meeting of the Board of Managers of the Washington Academy of Sciences held November 21, 1929, the report of the special committee on revision of the By-Laws was accepted. It was ordered that the proposed revised By-Laws be printed in the Journal of the Academy and be presented at the Annual Meeting of the Academy with the recommendation that they be adopted. The text of the proposed revision is attached.

L. B. TUCKERMAN,
Corresponding Secretary.

PROPOSED BY-LAWS

Article I—Members

Section 1.—The Washington Academy of Sciences shall be composed of three classes of members, as follows: Active members, honorary members and patrons.

Active members shall be classified as non-resident and resident members, those living within twenty-five miles of Washington being resident members.

The number of active members shall not exceed six hundred, of whom not more than four hundred shall be resident members, provided that non-resident may become resident members regardless of this limitation.

Members and honorary members shall be persons who by reason of original research or scientific attainment are deemed eligible to these classes. Persons who have given to the Academy not less than one thousand dollars or its equivalent in property, shall be eligible to election as patrons.

Section 2.—The annual dues of active members shall be five dollars; honorary members and patrons shall pay no dues. Members whose dues are in arrears for more than one year shall not be entitled to receive the publications of the Academy, and those in arrears for more than two years shall be dropped from the roll of the Academy, unless the Board of Managers (See Article II) shall otherwise direct.

Active members in good standing may be relieved from further payment of all dues by a single payment based upon the present worth of a life annuity of five dollars per year as determined by the Board of Managers.

Section 3.—Nominations for membership in any class shall be presented in writing at a meeting of the Board of Managers, endorsed by at least three members of the Academy or by an affiliated society (See Article VI). They shall be accompanied by a statement of the qualifications of the nominee and a list of his more important publications.

Section 4.—Election to membership shall be by vote of the Board of Managers. Final action on nominations shall be deferred at least one week after presentation and three fourths of the vote cast shall be necessary to elect. An election to active membership shall be void if the person elected does not within three months thereafter pay his dues or satisfactorily explain to the Board of Managers his failure to do so.

Article II—Officers

Section 1.—The officers of the Academy shall be a President, one Vice-President from each of the affiliated societies, a Corresponding Secretary, a Recording Secretary and a Treasurer, chosen from resident members, and two Vice-Presidents chosen from non-resident members whose term of office shall be one year; and six managers chosen from resident members, grouped in three classes of two each, whose term of office shall be three years. These officers and the Senior Editor (See Section 4) shall constitute the Board of Managers.

The newly elected officers shall take office at the close of the annual meeting (See Article III).

No member shall be eligible to hold office until one year after his election to membership.

Section 2.—The President and the Treasurer, when directed by the Board, shall jointly assign securities belonging to the Academy and indorse financial and legal papers necessary for the uses of the Academy, except those relating

to current expenditures authorized by the Board of Managers. In case of disability or absence of the President or Treasurer the Board of Managers may designate a Vice President as Acting President or an Officer of the Academy as Acting Treasurer, who shall perform all the duties of these offices, during such disability or absence.

Section 3.—The Board of Managers shall transact all business of the Academy not otherwise provided for. A majority vote with at least five affirmative votes shall be necessary for action. The Board shall have power to fill vacancies in its own membership until the next annual election. Vacancies in the office of Resident Vice-President shall be filled on nomination by the appropriate affiliated societies.

Section 4.—The Board of Editors shall consist of three members. One new member to serve three years shall be appointed each year by the President, who shall fill any vacancy which may occur. The President shall designate one of the Editors as Senior Editor.

ARTICLE III—MEETINGS

Section 1.—The annual meeting shall be held each year in January; it shall be held on the second Tuesday of the month unless otherwise directed by the Board of Managers. At this meeting the reports of the Secretaries, Treasurer, Auditing Committee, (See Article IV) and Editors of the Journal shall be presented and the resident Vice-Presidents for the ensuing year shall be elected.

Section 2.—Other meetings shall be held at such time and place as the Board of Managers may determine.

ARTICLE IV—COMMITTEES

Section 1.—The Board of Managers may provide for such standing and special committees as it deems necessary.

Section 2.—The President shall appoint in advance of the annual meeting an Auditing Committee consisting of three persons, none of whom is an officer, to audit the accounts of the Treasurer.

Section 3.—The Vice-Presidents shall constitute a Nominating Committee (See Article V). The Vice-President from the Philosophical Society shall be Chairman of the Committee; or, in his absence, the Vice-President from another society in the order of seniority as given in Article VI, Section 2.

Section 4.—On or before the last Thursday of each year the President shall appoint a committee of three tellers whose duty it shall be to canvass the ballots for officers.

ARTICLE V—ELECTION OF OFFICERS

Section 1.—Before the first day of November of each year the Nominating Committee, on being notified by the Corresponding Secretary, shall meet and organize; and shall then nominate, by preferential ballot, in the manner prescribed by the Board of Managers, one person for the office of President; two persons for the non-resident Vice-Presidents; one each for those of Recording Secretary, Corresponding Secretary, and Treasurer; and four for two Managers. It shall, at the same time, and in like manner, make nominations for any vacancy.

Not later than November 15, the Corresponding Secretary shall forward to each member a printed notice of these nominations, with a list of incumbent officers.

Independent nominations may be made in writing by any ten members. In order to receive consideration, such nominations must be forwarded to the Corresponding Secretary before the first day of December.

Not later than December 15, the Corresponding Secretary shall prepare and mail ballots to members. Independent nominations shall be included on the ballots, and the names of the nominees for each office shall be arranged in alphabetical order. Where more than two candidates are nominated for the same office the voting shall be by preferential ballot, in the manner prescribed by the Board of Managers. These ballots shall also contain a notice to the effect that votes not received by the Corresponding Secretary before the first Tuesday in January and votes of members whose dues are in arrears for one year will not be counted.

Before the Annual Meeting the tellers shall canvass the votes and report the results of the ballot to the Corresponding Secretary, who shall announce the vote at the annual meeting of the Academy.

Article VI—Cooperation

Section 1.—The Academy may act as a federal head of the affiliated scientific societies of Washington for the purpose of conducting joint meetings, publishing a joint directory and joint notices of meetings, and taking action in any matter of common interest to the affiliated societies: Provided, it shall not have power to incur for or in the name of one or more of these societies any expense or liability not previously authorized by said society or societies.

Section 2.—The term "affiliated societies" shall be held to cover the Philosophical Society of Washington; Anthropological Society of Washington; Biological Society of Washington; Washington Section, American Chemical Society; Entomological Society of Washington; National Geographic Society; Geological Society of Washington; Medical Society of the District of Columbia; Columbia Historical Society; Botanical Society of Washington; Archaeological Society of Washington; Washington Section, Society of American Foresters; Washington Society of Engineers; Washington Section, American Institute of Electrical Engineers; Washington Section, American Society of Mechanical Engineers; Helminthological Society of Washington; Washington Branch, Society of American Bacteriologists; Washington Post, Society of American Military Engineers, and such others as may be hereafter recommended by the Board and elected by two-thirds of the members of the Academy voting, the vote being taken by correspondence. A society may be released from affiliation on recommendation of the Board of Managers, and the concurrence of two-thirds of the members of the Academy voting.

Section 3.—One Vice-President may be nominated by each affiliated society from the resident members of the Academy, subject to election by a majority vote at the annual meeting of the Academy.

Article VII—Recognition of Merit in Scientific Work

Section 1.—The Academy may award medals and prizes, or otherwise express its recognition and commendation of scientific work of high merit and distinction.

Section 2.—Awards shall be made only on approval by the Board of Managers of a recommendation of a committee on awards.

·ARTICLE VIII—AMENDMENTS

These By-Laws may be amended in the following manner:

Written notice of the proposed change, signed by at least three resident members, may be presented at any meeting of the Board of Managers, which shall consider the proposed change and submit it (after two weeks printed notice) to the Academy for action, at or before the next annual meeting, with such amendment or recommendation as it deems wise. A two-thirds vote of the members voting shall be necessary to adoption. The action of the Academy on proposed amendments shall be reported at the next meeting of the Board of Managers, and published in the Journal.

SCIENTIFIC NOTES AND NEWS

Mr. E. P. HENDERSON of the U. S. Geological Survey has been appointed Assistant Curator of Applied Geology in the National Museum.

Mr. HENRY B. COLLINS, Assistant Curator of Ethnology, U. S. National Museum, returned recently from Alaska, where he has been engaged in field-work since April. Through the courtesy of the Coast Guard Service, Mr. Collins was enabled to visit on the steamship *Northland* most of the Alaskan coast and to collect specimens at the many stations visited. More than a month was spent in stratigraphical work on St. Lawrence Island in Bering Sea.

Dr. PAUL BARTSCH, of the U. S. National Museum, has returned from a trip to the West Indies, made under the auspices of the Walter Rathbone Bacon Travelling Scholarship. He visited all the islands between Porto Rico and Trinidad, excepting Antigua and Barbuda, which had been thoroughly explored by Mr. J. B. HENDERSON, and Barbados. After leaving Trinidad, his expedition sailed along the coast of South America, visiting the Leeward Islands, Margarita, Orchilla, El Roque, Bonaire, Curacao, and Aruba.

Dr. FRANK H. H. ROBERTS, JR., of the Bureau of American Ethnology has returned to Washington after five months in eastern Arizona, where he excavated 17 pit houses and a Pueblo ruin containing 45 rooms. The pit houses were found to represent the closing phase of the earliest sedentary culture in the Southwest. One of the most significant discoveries of the season's work was that of the remains of a complete pit house underlying one end of the Pueblo ruin, definitely showing that the pit house was an older form.

Prof. C. H. OSTENFELD, Director of the Botanical Garden and Museum, Copenhagen, Denmark, recently spent several days in Washington, giving particular attention to Alaskan plants in the National Herbarium, especially those of Arctic Alaska. His studies were undertaken in connection with the preparation of a flora of northern Canada, a project upon which he is jointly engaged with Dr. M. O. MALTE, Chief Botanist of the Canadian National Herbarium, Ottawa.

Dr. JOSEPH GRINNELL, of the University of California Museum of Vertebrate Zoology, and Mr. W. E. CLYDE TODD, of the Carnegie Museum, Pittsburgh, have recently been carrying on studies of the collections in the Division of Birds, National Museum.

Dr. R. Kimura, Chief Geologist of the Geological Survey of the South Manchuria Railway Company, spent several days in the National Museum looking over the exhibits and other collections of the Department of Geology. He expressed great appreciation of the completeness of the collections and was much interested in methods of geological mapping. Dr. T. Ito, assistant professor in the Tokyo Imperial University, also visited the Museum on November 11, his particular interest being in the mineral collections.

Dr. D. P. Curry, Assistant Chief of the Health Department at Balboa, Canal Zone, has been spending several days at the National Museum examining material in mosquitoes. For some years Dr. Curry has made a special study of the mosquitoes of his region. He has devised a new method for mounting genitalia, and brought with him some very fine material for comparison.

Secretary C. G. Abbot of the Smithsonian Institution attended the fall meeting of the National Academy of Sciences held at Princeton, N. J., on November 18 and 19, and presented a paper on "The Radiation of the Planet Earth to Space." Other members of the staff of the Institution attending the meeting were Dr. Aleš Hrdlička, who presented a paper on his latest explorations on the Yukon, and Dr. E. O. Ulrich.

On November 14 Assistant Secretary A. Wetmore spoke at the University of Michigan, Ann Arbor, Michigan, on *Life of the Hawaiian Bird Reservation*, and that same evening addressed a group of faculty members and graduate students at the University Museum on *The Research Work of the Smithsonian Institution.*

The survey yacht Carnegie and her scientific equipment were completely destroyed in the harbor at Apia, Western Samoa, on the afternoon of November 29, 1929, following the explosion of gasoline while it was being stored on the vessel. Captain James Percy Ault, in command, and one cabin boy were killed, the engineer and mechanic were seriously injured, and three of the sailors hurt. The scientific members of the staff with the exception of W. C. Parkinson, second in command, are expected with Captain Ault's body at San Francisco about December 19. Mr. Parkinson is remaining at Apia temporarily from which place he will proceed later to take charge of the Watheroo Magnetic Observatory in Western Australia.

The Carnegie was the property of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington and had completed about 45,000 nautical miles of her seventh cruise at the time of the accident. Since launching in 1909 she had traversed in all oceans from 80° north to 61° south, a total of nearly 300,000 nautical miles. The data gathered form valuable contributions to the science of geophysics including terrestrial magnetism and electricity, oceanography, and meteorology.

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A † denotes the abstract of a paper before the Academy or an affiliated society.

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